Massachusetts DEP

Residential Organic Waste Management Study

October 1999

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I. Background, Objectives, and Methodology

Background and objectives

In 1993, DEP commissioned a study to quantify the generation and diversion rates for the organic component of the solid waste stream in Massachusetts. The resulting report estimated generation and diversion for residential yard waste (leaves, grass, and brush) and commercial yard waste (yard waste and wood waste). The results have been used in DEP's solid waste planning.

This study is, in part, an update of the original study conducted in 1993. It focuses exclusively on the residential sector, however, and the objectives are somewhat broader than those of the 1993 report.

Specifically, the objectives of this study are to:

- Obtain a more current Solid Waste Master Plan organic waste diversion number;
- Evaluate the effects of DEP's composting outreach efforts;
- Determine the significance of residential on-site composting of food waste and paper waste in organic waste diversion;
- Identify barriers and motivators of residential on-site management of organic waste to aid in future program planning.

Survey Methodology

To meet the study objectives, we conducted a survey of Massachusetts's households. A complete copy of the questionnaire and topline survey results can be found in Appendix A.

Sampling

- All survey respondents are head or cohead of their household. They also have a yard for which they are responsible for maintaining.
- Respondents were sampled using random-digit dialing (RDD) to ensure a representative sample of households in the state.
- A representative sample of 400 qualified respondents from across Massachusetts were interviewed. In addition, an oversample of 100 qualified residents in communities with pay-as-you-throw (PAYT) programs were surveyed.

Interviewing

- Interviews were conducted using computer-assisted-telephone-interviewing (CATI). With CATI, a live interviewer uses an electronically programmed survey to efficiently and accurately administer and record the results of each interview.
- A pre-test of 15 interviews was conducted on June 25, 1999. Project team members from Research International and DEP monitored interviews during the pre-test and throughout the time the survey was in the field (June 25-30, 1999).
- The interview averaged 17 minutes in length and the survey received a high level of cooperation from qualified participants.

Data processing and weighting

- The data were processed and analyzed using SPSS.
- Overall statewide results are weighted to account for the oversample of residents living in communities with a pay-as-you-throw waste disposal system.

Reliability of results

- The overall statewide results are reliable to ±5.0 percentage points at the midpoint of 95% confidence level.
- Results for PAYT communities are reliable to ±7.5 percentage points at the midpoint of 95% confidence level.
- Statistically significant differences are noted in the text of the report. Differences not identified as statistically significant should be interpreted as general patterns and trends in the results.

Comparisons to 1993 study

- Results of the 1993 study discussed in this report are taken from the Tellus Institute report entitled Quantification of Organic Waste Stream Components in Massachusetts (1993) and an August 6, 1999 memorandum entitled "Revised Massachusetts Leaf and Yard Trimming Generation and On-site Diversion for 1992."

II. Key Findings and Recommendations

Level of participation in on-site diversion of organic waste[1]

- The percent of households diverting at least some of their yard waste on site is seven percentage points above the high level seen in 1993, a statistically significant increase ($p \leq .05$), (see p. 13).

  ⇒ Six out of seven (85%) residents divert at least some of their yard waste on site now, compared to 78% in 1993. Half (50%) of all residents compost yard waste, up from 28% in 1993 (see p. 14).

  ⇒ An estimated 52% (477,884 tons) of yard waste was diverted on site by residents in 1998, a 4-percentage point increase over the 1993 estimate (see p. 11).

- The percentage of residents composting food waste on site has increased to 25%, up eight percentage points from the 1993 level (see p. 49).

  ⇒ Massachusetts residents composted an estimated 76,241 tons of food waste in 1998 (see p. 94).

- One in twenty (4%) Massachusetts residents compost paper waste. In 1998, residents composted an estimated 3,229 tons of paper waste (see p. 98).

[1] On-site diversion includes composting, leaving yard waste on the ground, taking it to the woods, or chipping it for mulch.

Summary of Yard-Waste Management in Massachusetts in 1998

Massachusetts households generated an estimated 925,912 tons of yard waste in 1998. Grass clippings comprise the largest percentage of the total (592,584) amount of yard waste generated, followed by leaves (287,032), and plant trimmings and brush (46,296), (see p. 82). The table at the bottom of the page summarizes the disposition of all residential yard waste, including the estimated tonnage of waste diverted onsite, composted in curbside or drop-off programs, and put in the trash.

- Massachusetts households diverted an estimated 477,884 tons of yard waste on site in 1998, 52% of the total amount of yard waste generated in the Commonwealth (see p. 85).
- Meanwhile, residential households disposed of an estimated 44,442 tons of yard waste with the household trash (grass: 28,443; leaves: 13,777; and plant trimmings or brush: 2,222), five percent of the total amount of yard waste generated.
- Massachusetts residents manage the remaining yard waste (43% or 403,586 tons of yard waste; leaves: 149,183; grass: 224,016; and plant trimmings and brush: 30,387) by taking the waste to a community drop-off site or having the materials picked up by a curbside collection service.

Yard-Waste Generation and Management Tonnage: 1998

	Generation	Onsite Diversion	Curbside and Drop-off Composting Programs	Trash
Total	925,912	477,884	403,586	44,442
Leaves	287,032	124,072	149,183	13,777
Grass	592,584	340,125	224,016	28,443
Brush	46,296	13,687	30,387	2,222

PAYT and on-site diversion levels

- Residents in communities with PAYT programs are more likely to compost some of their food waste.

  ⇒ Four in ten (41%) residents in PAYT communities compost food waste, compared to 25% in towns without this type of waste-disposal program (see p. 52).

- With respect to yard waste, on-site diversion levels are five percentage points higher in PAYT communities (90% vs. 85% overall). Since on-site yard-waste diversion rates are high across the state, there is relatively little room for PAYT programs to impact behavior in this category (see p. 21).

DEP outreach efforts and on-site diversion

- Most compost bins purchased by residents originate from the town bin programs.

  ⇒ Nearly three-fourths (73%) of purchased compost bins in the state were bought through town-sponsored bin programs (see p. 55).

- People who compost food waste in bins also compost a greater portion of their food waste, compared to people using an open pile. Half (51%) of those who use a bin compost one-half or more of their food waste, while 42% of those who use an open pile compost half or more of their food waste (see p. 55).

- Half (45%) of respondents who compost (yard or food waste) say they have seen or heard information about composting from their municipality or the DEP (see p. 63).

- Most residents who recall seeing composting information saw it in the newspaper (see p. 70).

  ⇒ DEP should continue to use newspaper articles and ads for communicating information about composting.

The landfill bans and on-site diversion

- Awareness of the bans appears related to slightly higher levels of on-site diversion of yard waste, but awareness of the bans is relatively low (16%).

⇒ Nearly all (90%) of the residents who are aware of the bans manage at least some yard waste on site, compared to eight in ten (81%) of those who are not aware of the bans (see p. 25).

Yard-waste disposal services and on-site diversion

- Residents in communities with drop-off services for yard waste are more likely to divert waste on site, compared to residents in communities with curbside collection service (92% vs. 72%), (see p. 22).

Opportunities to increase diversion and composting

Yard waste

A very high percentage of residents already divert yard waste on site, making it difficult to significantly increase current levels of yard-waste diversion.

- DEP's efforts for yard waste should focus on maintaining high participation in on-site diversion and increasing the amount of yard waste residents manage on site.

DEP can maintain high participation rates and possibly increase participation by:

⇒ Continuing to communicate that diverting yard waste is convenient and good for the soil (see p. 68).

⇒ Continuing to provide information about how to compost yard waste (Among residents that don't compost yard waste, 14% say it is because they don't know how to do it.) (See p. 70).

⇒ Encouraging residents to divert as much of their yard waste as possible (see p. 84).

- All the messages tested in the survey indicate they would have some impact on the likelihood that residents who do not compost yard waste will begin to do so in the future (see p. 68).

Food waste

Because one-quarter of residents compost at least some of their food waste, a significant portion of the MSW could be diverted through food-waste composting.

- Food waste can be diverted from the MSW by increasing the number of residents who compost food waste and the amount of food waste residents compost.
- In response to messages tested in the survey, a significant portion of residents say they are at least somewhat likely to start composting food waste.

    ⇒ Across the seven messages tested in the survey, approximately 30% of residents that aren't composting food waste now said they would be very or somewhat likely to start—including those who currently use garbage disposals for some of their food waste (see p. 73).

To increase the percent of residents that compost food waste, DEP should focus on the following groups:

- People that currently compost yard waste, but not food waste;
- People with gardens and plantings;
- People in PAYT communities.

    ⇒ The survey results indicate that these three characteristics, particularly yard waste composting, significantly predict likelihood to compost food waste (see p. 57).

When communicating with the residents about food-waste composting, DEP should focus on the following points.

- The environmental and horticultural benefits of composting food waste: When asked about the biggest benefits of composting food waste, nearly one-half (48%) of residents cite environmental benefits and 68% mentioned horticultural benefits (see p. 51).
- Concerns about pests are a significant barrier to food-waste composting.
  - A significant number (30%) of residents don't compost *any* food waste because of concerns about pests. Further, some people don't compost *more* of their food waste because of concerns about pests (see p. 53).
  - DEP's communications and outreach programs should continue to emphasize that, when done properly, food-waste composting will not attract rodents and pests. Since this is likely to be an area where people are skeptical, word-of-mouth or testimonial-type messages may help to convince people.
- The DEP should continue to make instructions on composting food waste available because one in seven (14%) say they don't know how to do it.
- This survey indicates that the bin distribution program is one of the best mechanisms for encouraging food-waste composting (see p. 76).
  - ⇒ Nearly one-half (47%) of those who purchased bins from a town program did not compost any food waste before they got the bin from the town (see p. 55).
  - ⇒ Promoting the rodent-resistant bins should help address concerns about pests and rodents.

Paper waste

Only one in twenty (4%) residents currently compost paper waste, primarily because they don't know it can be composted or how to compost it (see p. 59).

- ⇒ DEP should be able to increase paper composting by simply providing information to residents about how to compost paper waste.
- ⇒ DEP should also target paper-waste composting information to households that already compost other organic materials (see p. 78).

III. Overall On-site Diversion of Yard Waste

In order to provide an overview of the generation and treatment of residential yard waste in Massachusetts, this chapter describes yard-waste generation totals and diversion practices at an overall level. In this context, overall yard waste includes the combination of leaves, grass, and brush. The following chapter summarizes diversion practices for leaves, grass, and brush separately.

Total Generation and On-site Diversion of Yard Waste

- Massachusetts residential yards generated an estimated 925,912 tons of yard waste in 1998 (this total includes both MSW and on-site diversion totals).[2]

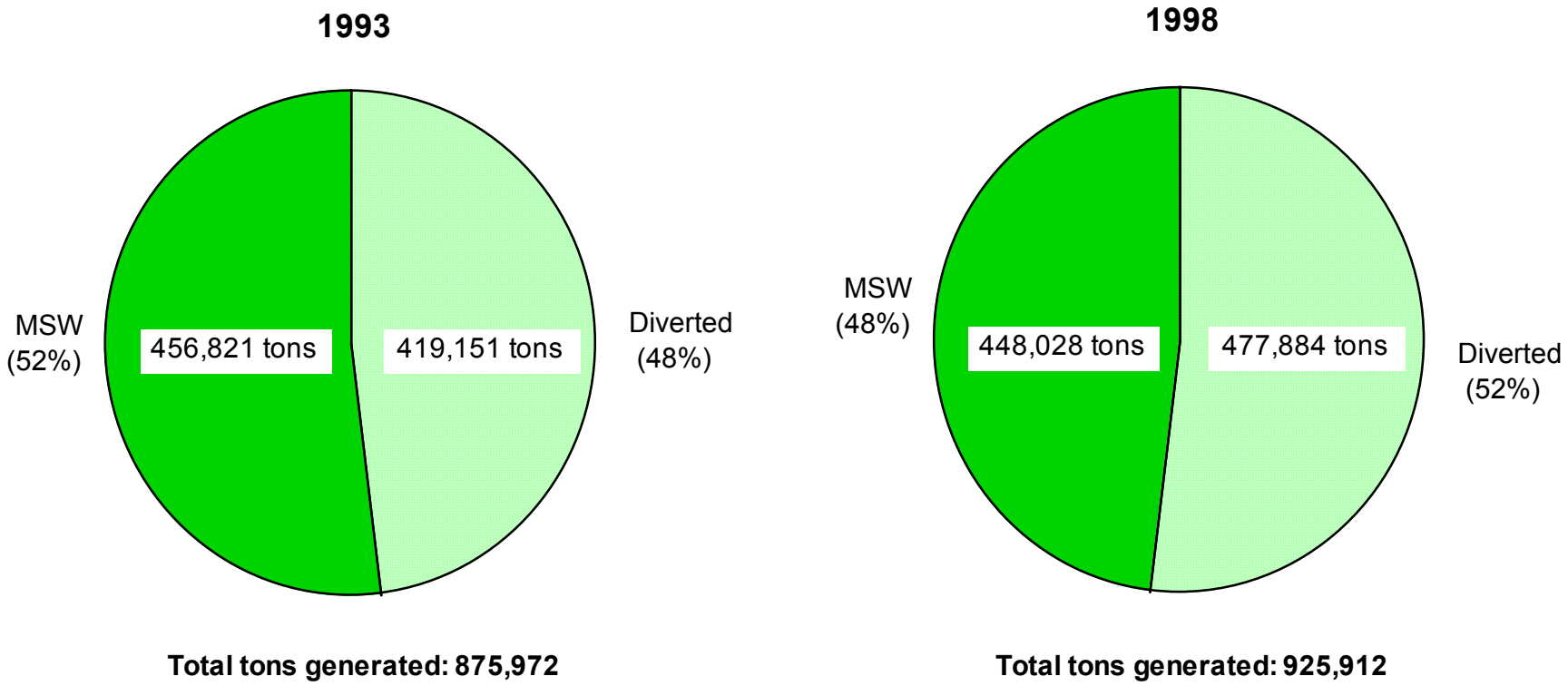
  ⇒ Yard-waste generation increased six percent since the 1993 study (875,972 tons). This increase in generation is due to the increased number of dwellings in the state.

- One-half of yard waste (52% or 477,884 tons) is diverted on site.

  ⇒ On-site diversion of yard waste has increased four percentage points (57,517 tons) since 1993.

[2] For details on the methodology for quantifying the generation and diversion of yard waste, see Chapter IX of this report, and the Tellus Institute, "Memorandum: Revised Massachusetts Leaf and Yard Trimming Generation and Onsite diversion for 1992," August 6, 1999. In this report, organic waste management practices reported in 1999 were used to determine generation and management tonnages for 1998.

Proportion of Total Residential Yard Waste Generated in the MSW and Diverted On Site: 1993 vs. 1998

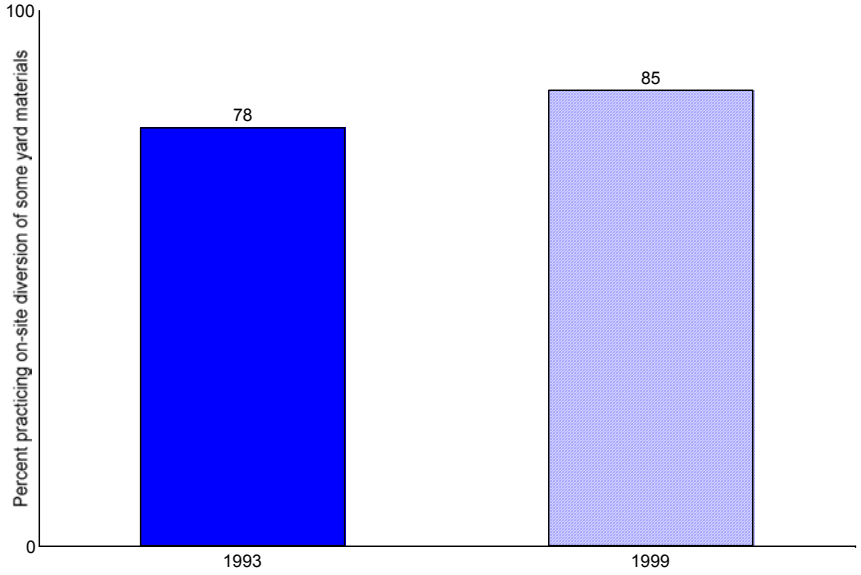


Note: Percentages of total will not exactly equal tonnage due to rounding

Number of Residents Diverting Yard Waste On Site

- Since all survey respondents in this study have a yard they are responsible for maintaining, virtually all respondents (99%) manage at least some form of yard waste (leaves, grass, or brush).
- Overall, six out of seven (85%) Massachusetts residents say they practice some form of on-site diversion of their yard-waste materials, up seven percentage points from 1993 (78%; difference is statistically significant at $p \leq .05$).[3]

On-site Diversion of Yard Waste: 1993 vs. 1999

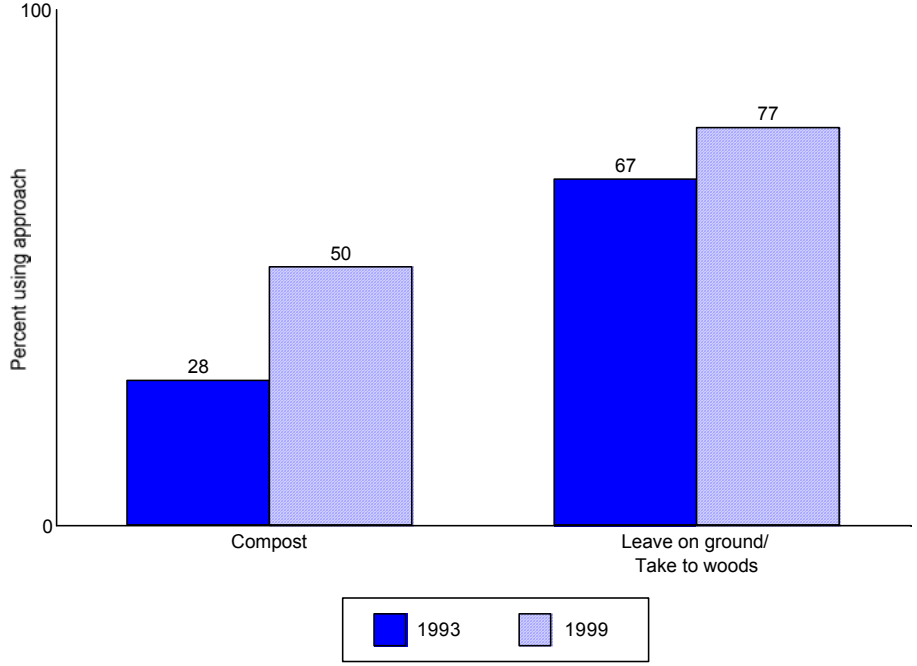


[3] On-site diversion includes composting, leaving yard waste on the ground, taking it to the woods, or chipping it for mulch.

Methods of On-site Diversion

- The number of residents who compost yard waste has risen sharply since 1993. Half (50%) of all respondents report that they compost at least some of their yard waste, a number that is nearly twice as high as that reported six years ago (28%; difference is statistically significant at $p \leq .05$).
- Further, three-fourths (77%) of residents say they divert at least some of their yard waste on site in ways other than composting (i.e., let stay on the ground, take to the woods, or chip for mulch), a 10-percentage point increase over 1993 (67%; difference is statistically significant at $p \leq .05$).

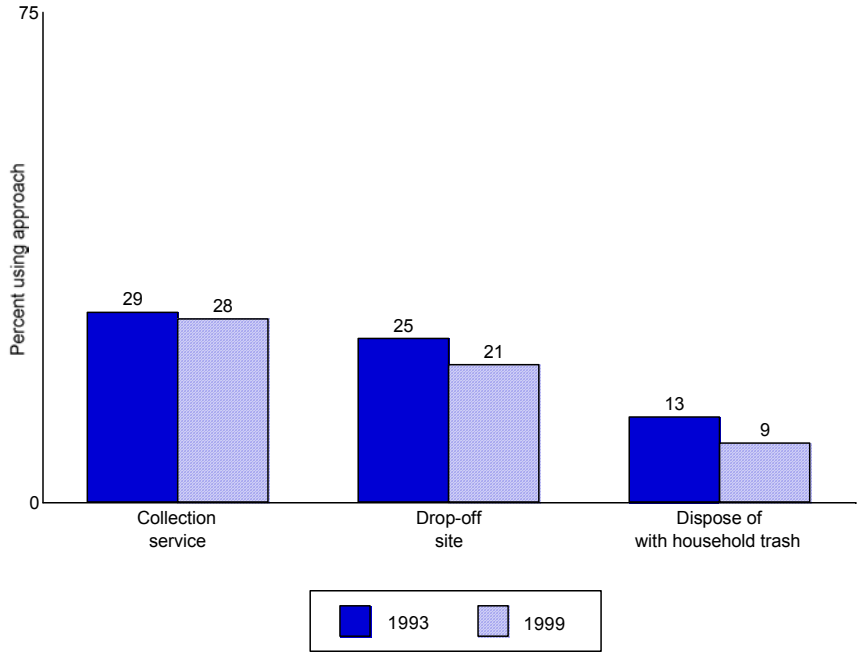
Composting and Leaving Yard Waste on the Ground: 1993 vs. 1999



Yard Waste Disposed of in the Trash, Brought to a Drop-off Site, or Picked Up at Curb

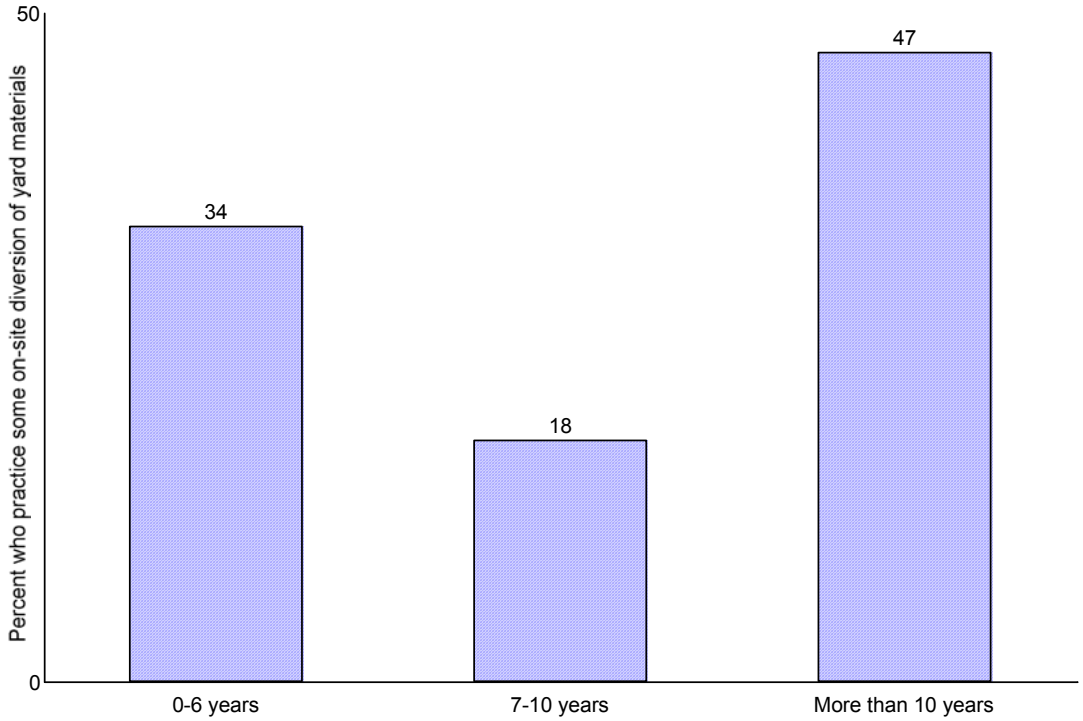
- In contrast, the percent of residents who treat at least some of their yard waste in ways other than diverting the material on site has either declined or remained stable since 1993.
  - ⇒ The number who report taking at least some yard waste to a drop-off site has declined (25% vs. 21% in 1999), as have the number who report putting yard waste out with the household trash (13% vs. 9%).
  - ⇒ An estimated 44,442 tons of yard waste was disposed of in the trash in 1998.
  - ⇒ Meanwhile, the number who say they put at least some yard waste out for curbside collection by their town or a private collection service is nearly identical to that reported six years ago (29% vs. 28% in 1999).

Treatment of Yard Waste in Ways Other than On-site Diversion: 1993 vs. 1999



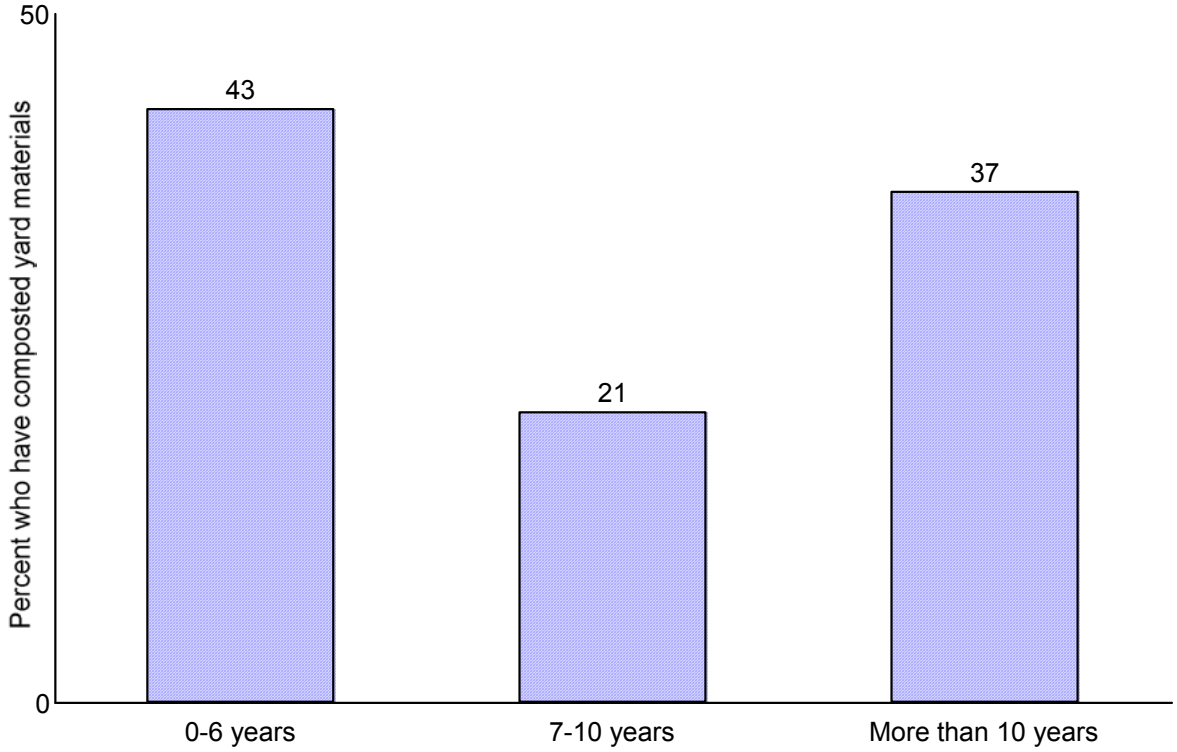
- Three in ten (34%) of those who divert yard waste on site began doing so within the past six years, after the compost bin grant program and last of the bans on putting yard waste into the state's landfills went into effect. (The leaf ban went into effect December 31, 1991, and the grass and brush ban on April 1, 1993).
- Two in ten (18%) say they began diverting yard waste seven to ten years ago, while half (47%) of those who divert yard waste began the practice more than a decade ago.

Length of Time Diverting Yard Waste On Site



- A large proportion of those who compost yard waste recently began the practice. Among those who compost yard waste, four in ten (43%) began the practice within the past six years (and 25% began within the past three years).
- Two in ten (21%) residents who compost yard waste started seven to ten years ago, and more than one-third (37%) began composting more than ten years ago.

Length of Time Composting Yard Waste



Reasons for Diverting Yard Waste

- Residents frequently say they began leaving their yard waste on the lawn, or taking it to the woods, because it is easier than bagging (26%) or simply convenient (9%).
- The benefits to the soil and the environment are also frequently mentioned as reasons for diverting yard waste.
  - ⇒ One-third (33%) of residents who divert yard waste say they began doing so because it is *good for the soil*.
  - ⇒ Some (2%) also say it is *good for the environment* in general.
- Most people compost yard waste because of the benefits it provides for plants and the soil.
  - ⇒ Two-thirds (70%) of residents who compost yard waste say they do so because it is healthy for either their garden (29%) or their flower bed (6%), enriches the soil (23%), or creates more fertilizer (12%).
  - ⇒ 22% say they compost because it is good for the environment (12%), recycles natural resources (6%), or saves landfill space (4%).
- Composting is also viewed as a convenient alternative among a large segment of respondents. Nearly one quarter (23%) of those respondents who compost their yard waste say they compost because it is an easy means of managing yard waste.
- Conversely, the reasons residents most frequently cite for not composting any yard waste are that they are either too busy to compost (25%) or don't have enough space (24%).
  - ⇒ However, one in seven (14%) residents report that they *don't know how to compost yard waste*. A lesser number of respondents say they *do not have enough yard waste* to compost (9%) or that *composting is too much work* (9%).

Main Reasons for Leaving Yard Waste on the Ground or Taking it to the Woods (Total Responses)

Reason	***Percent Who Mention***
Good for the soil	33
Easier than bagging	26
Convenience/No time	9
Good for environment	2

Main Reasons for Composting Yard Waste (Total Responses)

Reason	*Percent Who Mention*
Good for the garden	29
Enriches the soil	23
Easy means of disposal	23
Creates more fertilizer	12
Good for the environment	12
Adds to compost pile	8
Recycling natural resources	6
Use it in flowerbed	6
Saves money	4
Saves landfill space	4

Impact of Pay-as-you-throw Programs on Overall On-Site Diversion of Yard Waste

- Overall, respondents who live in pay-as-you-throw (PAYT) communities, where residents must pay for each bag of trash they throw away, are slightly more likely to practice on-site diversion of their yard-waste materials than are those who do not reside in a PAYT community.

  ⇒ Nine in ten (90%) of those who live in a PAYT community practice on-site diversion of at least some of their yard waste, compared to 85% in communities without PAYT.

  ⇒ Similarly, six in ten (59%) of those residing in a PAYT community report that they compost their yard waste, compared to half (50%) of those in communities without PAYT.

  ⇒ One explanation for the similar levels of on-site diversion among those residing in PAYT communities and those who do not is that on-site diversion rates are already high in both types of communities. There is not much room for growth.

- The reasons residents mention for engaging in on-site diversion are also similar among both those who live in PAYT communities and those who do not. Residents most frequently say it is good for the soil (33% each) and easier than bagging (26% vs. 22%).

  ⇒ Respondents from PAYT communities do not mention a desire to avoid having to pay to throw more garbage away as a reason for beginning to engage in on-site diversion of yard waste.

- Further, the existence of a PAYT program in a community does not appear to impact the number residents who report throwing their yard waste away with the household trash. The number of respondents from PAYT communities who report discarding their yard waste with the household trash is identical to the number of respondents who do not reside in a PAYT community (9% each). Bear in mind that the number of residents who report throwing yard waste out in the trash is very low, leaving little room for PAYT programs to produce differences.

Impact of Curbside vs. Drop-off Yard-waste Programs on Diversion

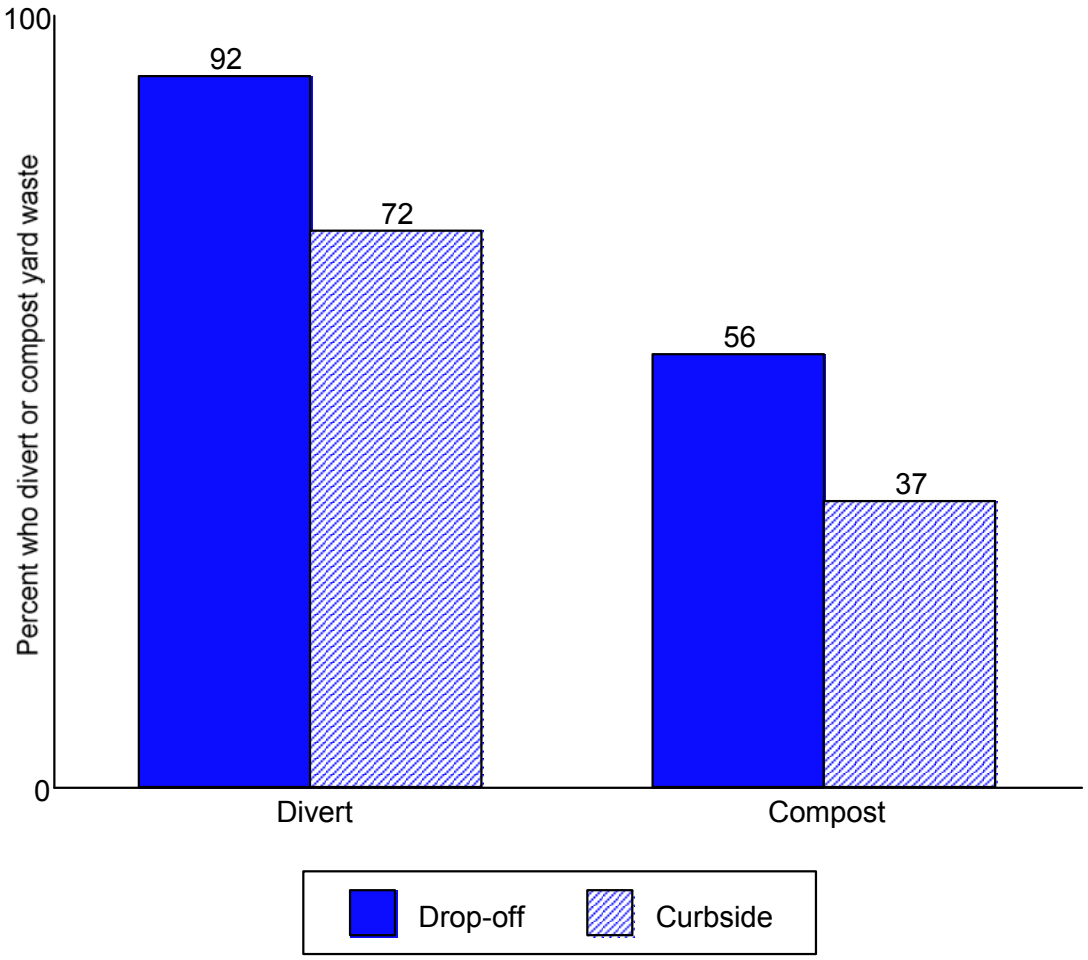
A curbside collection program is one in which residents put their yard waste out at the curb for collection. Meanwhile, residents who live in towns with a drop-off program must take their yard waste to a designated composting site. Since residents who live in a community with a drop-off yard waste program must haul their leaves to a disposal site themselves, there is more incentive for residents from these communities to divert yard waste at a higher rate than those who live in towns with a curbside collection program, where residents can put their yard waste out at the curb for the town to pick up.

⇒ As expected, those living in a community with a drop-off collection program are more likely to divert yard waste on site than those who live in a community with a curbside program (92% vs. 81%; difference is statistically significant at $p \leq .01$).[3]

⇒ Looking at composting in particular, residents in towns with a drop-off collection program are more likely to compost yard waste than those who live in communities with curbside programs (56% vs. 37%; difference is statistically significant at $p \leq .01$).

[3] Some overlap with PAYT communities exists and may influence the results. One in five (23%) of those living in communities with a drop-off program also live in a PAYT community.

Impact of Curbside vs. Drop-off Yard-waste Collection Programs on On-site Diversion



Demographic and Lifestyle Influences on Yard-waste Diversion

Home ownership and gardening are significantly related to higher levels of on-site diversion.

⇒ Homeowners are more likely to practice on-site diversion of their yard waste than are respondents who do not own their home (87% vs. 78%; difference is statistically significant at $p \leq .01$).

⇒ In addition, those who report that they have a garden or plantings at their home are far more likely to compost yard waste than are those who do not have a garden (60% vs. 30%; difference is statistically significant at $p \leq .01$).

Other demographic characteristics such as age, income, and education also correlate with higher rates of on-site diversion and composting, but not at a statistically significant level.

- Older respondents, and those with a college education, report slightly higher levels of on-site management than do those from other demographic groups.[4]

  ⇒ College graduates (89%) are more likely to manage some of their yard waste on site than are those respondents with less than a college education (82%).

  ⇒ Residents 36 to 55 years of age (87%), and 56 years of age and older (85%), are slightly more likely to practice on-site diversion than those 35 years of age and under (81%).

- The same patterns generally exist in PAYT communities.[5] Nearly all (99%) college graduates who reside in PAYT communities report that they practice some form of on-site management, while 82% of those with less than a college education manage yard waste on site.

- Composting is also related to both age and education levels. College graduates (52%) report higher rates of composting than those with less than a college education (44%). Respondents 56 years of

[4] Older respondents and college graduates are more likely to be homeowners. However, these results are consistent among homeowners as well.
[5] Bear in mind that sample sizes are small among these segments of residents from PAYT communities (30 respondents or less), and it is necessary to use caution when interpreting the results.

age and older (58%) are more likely to compost than those 36-to-55 years of age (49%) or 35 years of age and under (40%).

Impact of Awareness of Landfill Bans on Yard-waste Diversion

Although bans on putting yard waste in landfills have been in place in Massachusetts for about seven years, a relatively small number of residents are aware of the bans.

- Only one in eight (16%) residents say they are aware of a ban on the disposal of yard waste in Massachusetts landfills. Four in ten (44%) say they are not sure if a ban is in place, and a similar number believes that no law currently bans the disposal of yard waste in the state's landfills (40%).

  ⇒ Awareness of the ban is highest among older residents (36 years of age and older) and those living in the eastern part of the state (617 and 508 area codes). It is lowest among younger respondents (under 36 years of age) and those in the western part of the state (413 area code). However, sample sizes among these groups are very small and results should be interpreted with caution.

  ⇒ Awareness of the ban is slightly higher among residents in PAYT communities (21%).

- Those aware of the bans are 9% more likely to divert yard waste on site than are those who are unaware.

  ⇒ Nine in ten (90%) of those who are aware of the ban divert at least some of their yard waste on site, while eight in ten (81%) of those who are not aware of the ban report that they manage their yard waste on site.

IV. Diversion of Leaves, Grass, Plant Trimmings, Brush

This section discusses the findings for each category of yard waste: leaves, grass, and brush. It addresses the types of yard-waste management practices employed for each form of yard waste, as well as the amount of material respondents handle in each fashion. Where appropriate, results are compared to the 1993 survey.

The yard-waste management results discussed in this chapter are used to estimate the rate at which leaves, grass, and brush are diverted on-site.

- As shown in the table below, an estimated 43.23% of leaves, 57.39% of grass, and 29.56% of brush were diverted on-site in 1998.
- The percentage of yard waste managed on site has increased slightly since 1993 within each category of yard waste.
- Of the three types of yard waste, on-site diversion of grass has increased most since 1993 (up nearly 5 percentage points to 57.39).

Percentage of Yard Waste Diverted Through On-site Management

	Leaves	***Grass***	***Brush***
1998	43.23	57.39	29.56
1993	41.08	52.57	28.84

Leaves

Nearly all respondents (90%) report that they have fallen leaves in their yard.

⇒ Based on the survey results, Massachusetts residents generated an estimated 287,032 tons of leaves in 1998.

- Among households with leaves, four in ten (46%) say that they compost the leaves, while somewhat fewer (41%) either let the leaves stay on the ground or take them to the woods.

  ⇒ The number of respondents who report composting at least some of the leaves in their yard has increased 20 percentage points since 1993 (26% vs. 46%; a statistically significant difference at $p \leq .01$).[7]

  ⇒ An estimated 43% (124,072 tons) of leaves are diverted on site, a 2-percentage point increase since 1993 (41%).

- One-fourth (25%) report taking their leaves to a community drop-off site, and an identical number (25%) have their leaves picked for composting by the town or a private collection service.

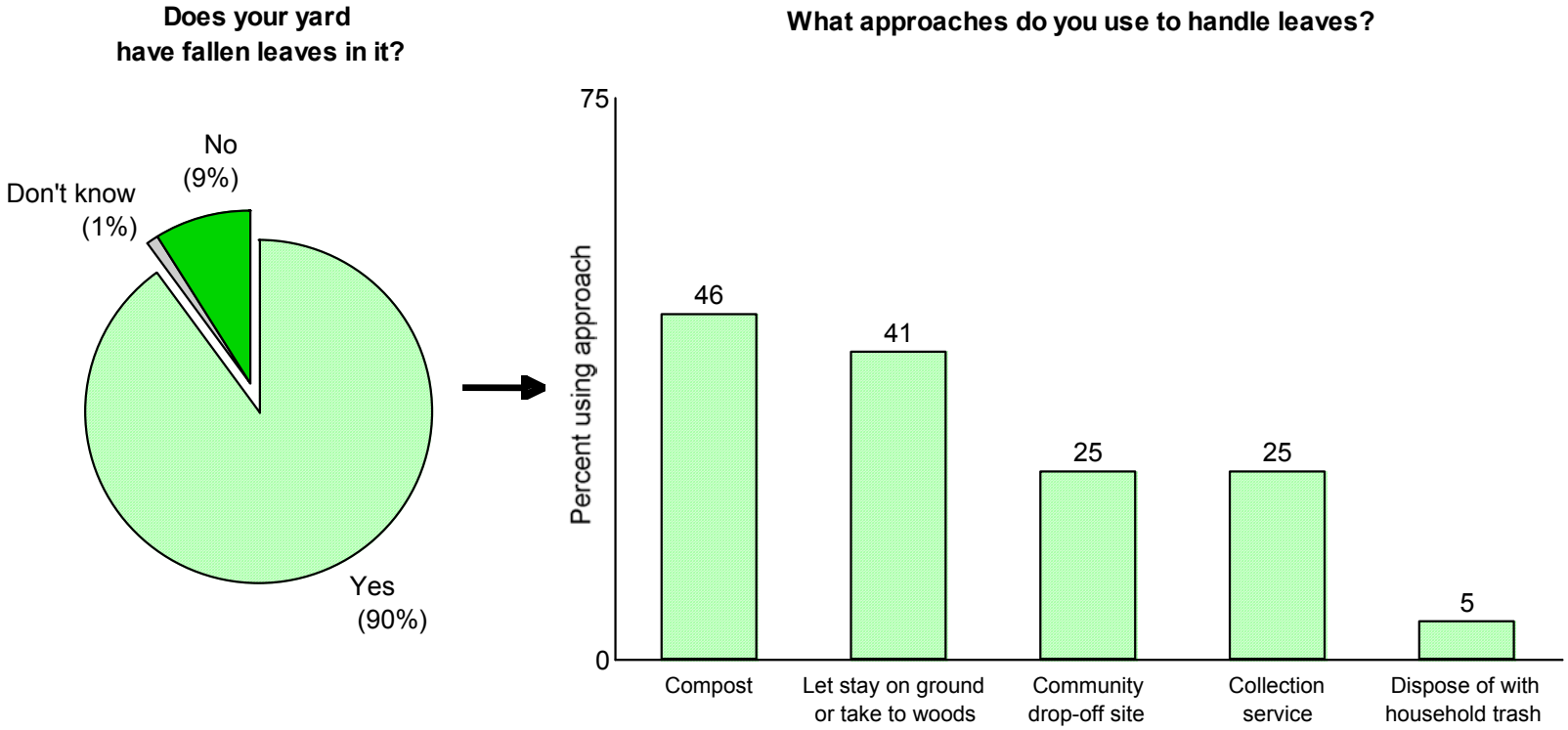
- Few respondents say that they dispose of leaves with the household trash (5%).

- An estimated total of 13,777 tons of leaves were disposed of in household trash in 1998.

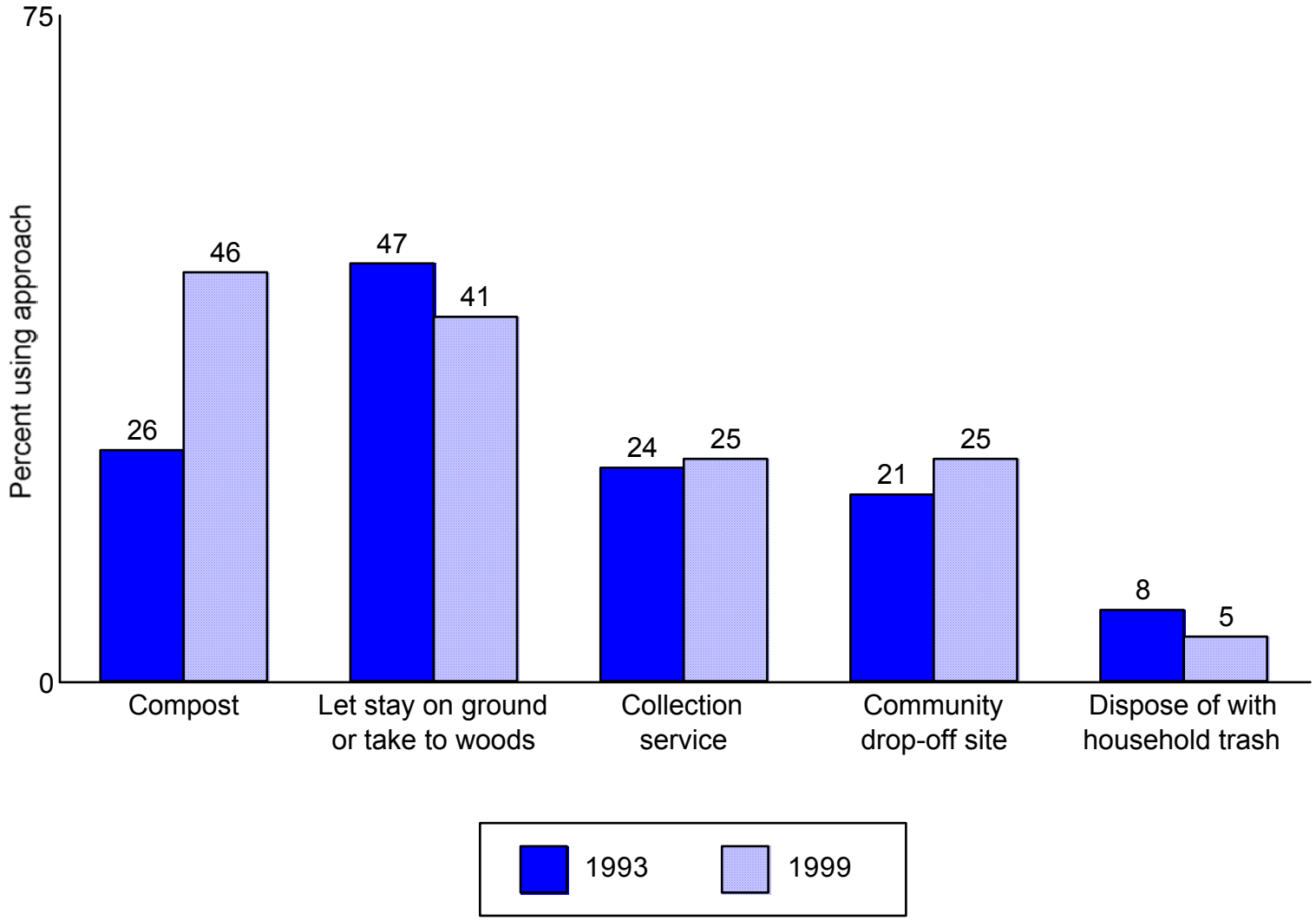
  ⇒ The number of respondents who let their leaves stay on the ground or take them to the woods declined (47% vs. 41%) over the past six years, as did the number who dispose of leaves with the household trash (8% vs. 5%). Residents from the 617 area code appear more likely to dispose of leaves with the household trash than do those from other parts of the state (21% in 617 vs. 3% in other area codes). However, sample sizes are very small (less than 10 respondents), and it is necessary to use caution when interpreting these results.

  ⇒ The number of respondents who report having their leaves picked up by a collection service (24% vs. 25%) increased one percentage point over 1993, while the number who take them to a community drop-off site (21% vs. 25%) increased four percentage points.

Treatment of Leaves



Treatment of Leaves: 1993 vs. 1999



Amount of Leaves Handled by Each Method

- Among those who compost their leaves, four in ten (39%) compost either all of the leaves in their yard (29%) or more than three-fourths of the leaves (10%). Meanwhile, two in ten (19%) report composting one-half to three-fourths of the leaves in their yard.

  ⇒ Still, two in ten (19%) say they compost one-fourth to one-half of the leaves in their yard and a nearly identical number (17%) state that they compost less than one-fourth of the leaves.

- Half (56%) of those who allow their leaves to stay on the ground, or take them to the woods, treat either all of their leaves (42%) or more than three-fourths of their leaves (14%) in this fashion.

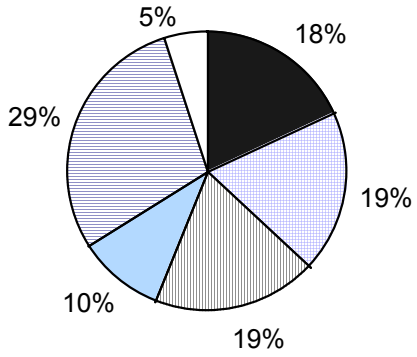
  ⇒ A smaller number allow either one-half to three-fourths (16%), one-fourth to one-half (9%), or less than one-fourth (18%) of their leaves remain on the ground.

- A small number (5%) of respondents report throwing their leaves away with the household trash. Among this group, three in ten (31%) report disposing of less than one-fourth of their leaves in this manner.

  ⇒ However, one-fourth (24%) say they dispose of all of their leaves by throwing them in the household trash, and a similar number (22%) report disposing of one-half to three-fourths of their leaves in this way.

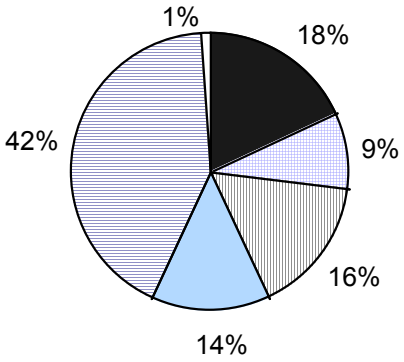
Amount of Leaves Handled by Each Method: 1999

Compost



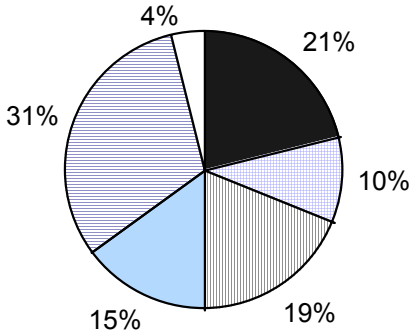
Percent who compost amount of leaves

Ground/woods



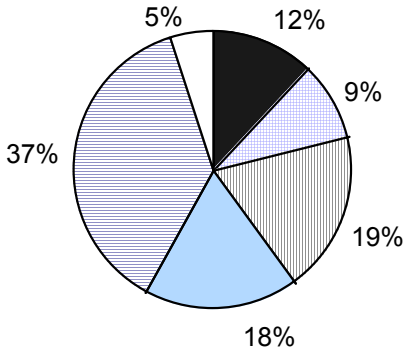
Percent who let amount stay on ground or take to woods

Drop-off site



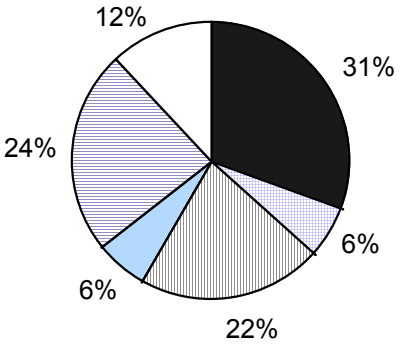
Percent who take amount to drop-off site

Collection service



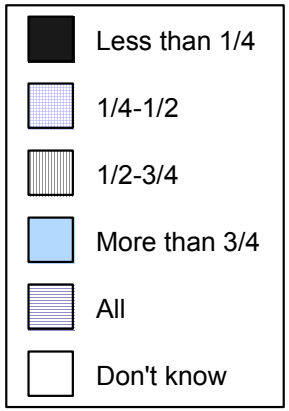
Percent who have amount picked up

Dispose with trash



Percent who dispose of amount with trash

Proportion of material handled (clockwise)



Compared to the 1993 results, residents are diverting smaller portions of their leaves on site and off site. The length of time residents have been diverting yard waste, as well as differences between the 1993 and 1999 surveys, may contribute to these results.

- The number of residents who say they let half or more of their leaves stay on the ground, or take them to the woods, has declined nine percentage points since 1993 (81% vs. 72%; a statistically significant difference at $p \leq .05$).
- Similarly, the number who report composting half or more of their leaves has dropped six percentage points from six years ago (64% vs. 58%).

    ⇒ Residents are diverting smaller portions of their leaves on site. However, this is countered by a significant increase in the number of people participating in on-site diversion since 1993. As a result, the overall percentage and tonnage of yard waste diverted on site has increased.

One explanation for the decline in the amount of leaves residents divert on site since 1993 is the length of time residents have been diverting yard waste. The longer residents practice on-site diversion (let stay on the ground, take to the woods, or compost), the more of their yard waste they tend to handle this way.

- Thus, the relatively large number of residents who began diverting their leaves on site within the past six years (30% let stay on ground/take to woods, 41% compost) may account for the apparent discrepancy between the increase in the percentage of leaves diverted on site since 1993, and the decrease in the proportion of leaves residents divert on site.

    ⇒ Four in ten (46%) of those who have let their leaves stay on the ground (or have taken them to the woods) for three years or fewer handle one-half or more of their leaves in this fashion, compared with seven in ten (72%) of those who began the practice four to seven years ago and eight in ten (79%) of those who started handling their leaves this way eight or more years ago.

⇒ Similarly, half (50%) of those who began composting within the past three years report that they compost half or more of their leaves, compared with 57% of those who began composting four to seven years ago and 61% of those who have composted their leaves for eight years or more.

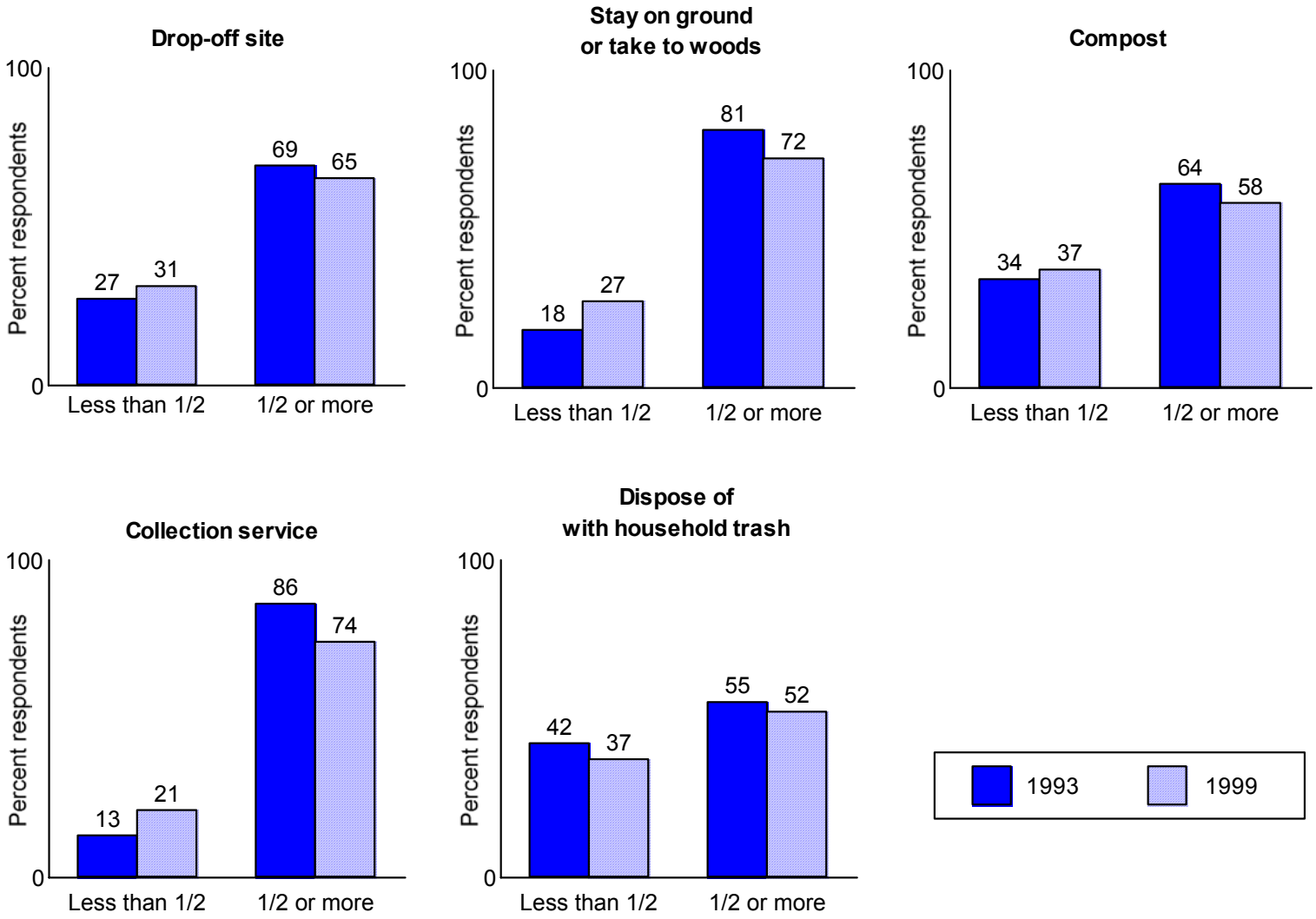
Changes in the design of the survey from 1993 to 1999 may also account for some of the differences between the 1993 and 1999 results.

- In 1993, residents who handled more than three-fourths of their leaves in a particular fashion (i.e., composting, letting them stay on the ground, taking them to the woods, etc.) were considered to treat all of their leaves in this fashion and were not asked further questions about the remainder of their leaves. Thus, the 1993 survey did not ask respondents to account for 100% of their leaves.
- In contrast, the 1999 survey had a provision for respondents to say they handled all of their leaves in a particular fashion. Therefore, those who said more than three-fourths of their leaves were handled in a particular fashion were also allowed to say they handled less than one-fourth of their leaves in another manner, something for which the 1993 study did not allow. In this way, the 1999 survey asked respondents to account for 100% of their leaves.

  ⇒ Although a more precise accounting of the amount of leaves residents handle in a particular fashion, this difference may have resulted in slightly different numbers in 1999 as compared with the 1993 results.

- Apart from on-site management of leaves, the number of residents who report that they take one-half or more of their leaves to a drop-off site (69% vs. 65%), or throw one-half or more their leaves in the trash (55% vs. 52%) has declined since 1993. The number of residents who report having one-half or more of their leaves picked up by a collection service has also declined (86% vs. 74%; a statistically significant difference at $p \leq .05$).

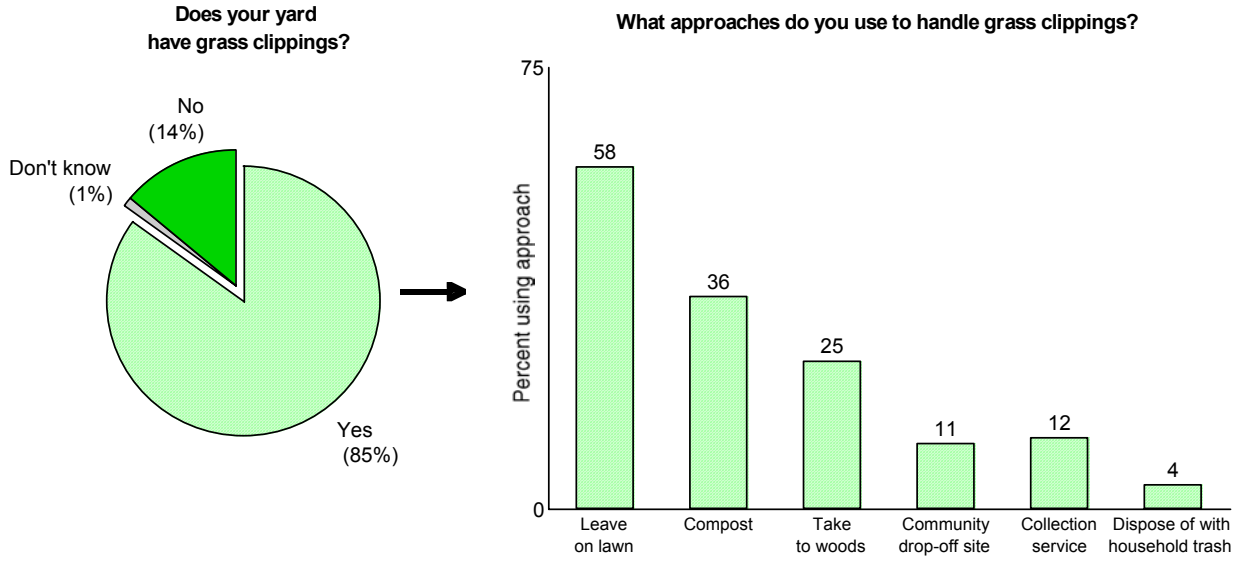
Amount of Leaves Handled by Each Method: 1993 vs. 1999



Grass

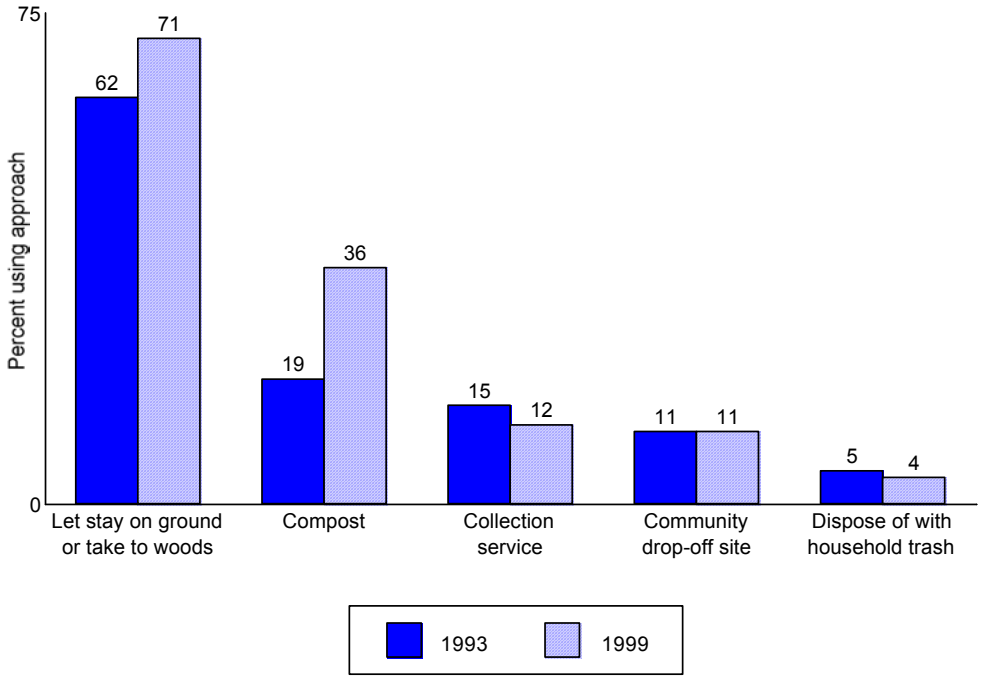
- Massachusetts generated an estimated 592,584 tons of grass clippings in 1998.
  - ⇒ Of this total, 57% is diverted on site, an increase of four percentage points over 1993 (53%).
- Most respondents (85%) report having grass clippings on their lawn.
- Among this group, six in ten (58%) leave the materials on the lawn and one-third (36%) compost the grass clippings. Somewhat fewer residents (25%) take the grass clippings to the woods.
- One in ten residents either take their grass clippings to a community drop-off site (11%) or have them picked up by the town or a private collection service (12%), while one in twenty residents report throwing grass clippings away with the household trash (4%).

Treatment of Grass Clippings



- The percent of residents who compost grass clippings in 1999 is up 17 percentage points over 1993 (19% vs. 36%; a statistically significant difference at p≤.01). Similarly, the number of residents who leave their grass clippings on the lawn, or take them to the woods, has increased nine percentage points from six years ago (62% vs. 71%; a statistically significant difference at p≤.05).
- On the other hand, the number of respondents who say they have their grass clippings picked up by a collection service (15% vs. 12%), take them to a community drop-off site (11% vs. 11%), or dispose of grass clippings with the household trash (5% vs. 4%) has declined or remained stable since 1993.

Treatment of Grass Clippings: 1993 vs. 1999



- In 1999, half (55%) of those who say they leave their grass clippings on the lawn or take them to the woods treat all (41%) or more than three-fourths (14%) of their grass clippings in this fashion. Meanwhile, two in ten (20%) say they leave one-half to three-fourths of their grass clippings on the lawn.

  ⇒ A lesser number state that they leave either one-fourth to one-half (11%) or less than one-fourth (13%) of their grass clippings on the lawn.

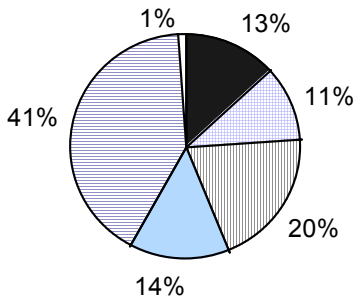
- Among those who compost grass clippings, four in ten (40%) report composting all (31%) or more than three-fourths (9%) of their grass clippings. One in seven respondents compost one-half to three-fourths (15%) of their grass clippings, while two in ten report composting one-fourth to one-half (20%) or less than one-fourth (20%) the grass in their yard.

- Similarly, one-third (36%) of those who take their grass clippings to the woods say that they treat all (26%) or more than three-fourths (10%) of their grass clippings in this fashion. Meanwhile, two in ten residents take one-half to three-fourths (22%) or one-fourth to one-half (17%) of their grass clippings to the woods. A similar number (21%) say they dispose of less than one-fourth of their grass clippings by taking them to the woods.

- Seven in ten (71%) of those respondents who throw grass clippings out with the household trash say they dispose of either all (55%) of their grass clippings or more than three-fourths (16%) of their clippings in this manner. One in ten (11%) throw one-fourth to one-half of their grass clippings out with the household trash, while a somewhat greater number (18%) dispose of less than one-fourth of their grass clippings this way. In 1998, Massachusetts residents disposed of an estimated 28,443 tons of grass clippings with household trash.

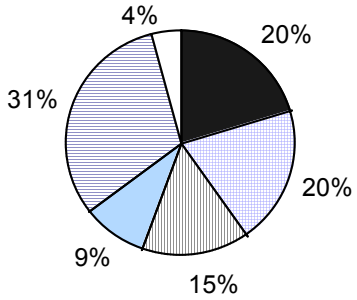
Amount of Grass Clippings Handled by Each Method

Leave on lawn



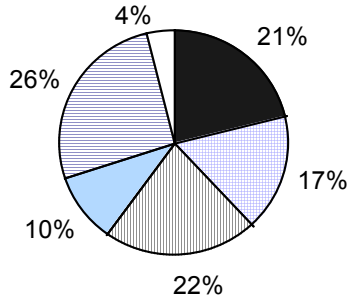
Percent who leave amount on lawn

Compost



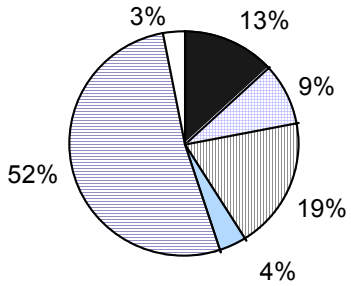
Percent who compost amount of grass

Take to woods



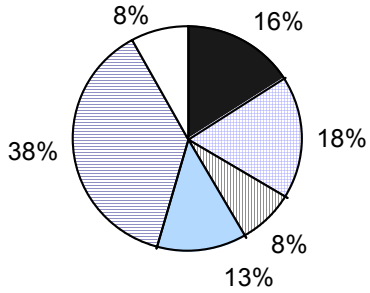
Percent who take amount of grass to woods

Drop-off site



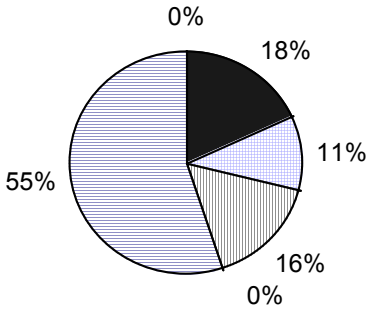
Percent who take amount to drop-off site

Collection service



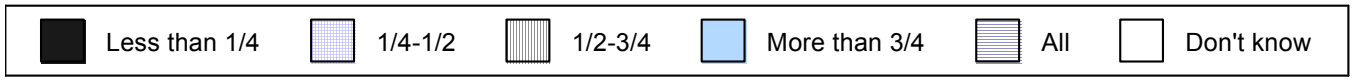
Percent who have amount picked up

Dispose with trash



Percent who dispose of amount with trash

Proportion of material handled (clockwise)



As with leaves, the reason for the increase in the percentage of grass clippings Massachusetts residents manage on site is the rise in the number of residents diverting their grass clippings at home, rather than the amount of grass clippings they divert.

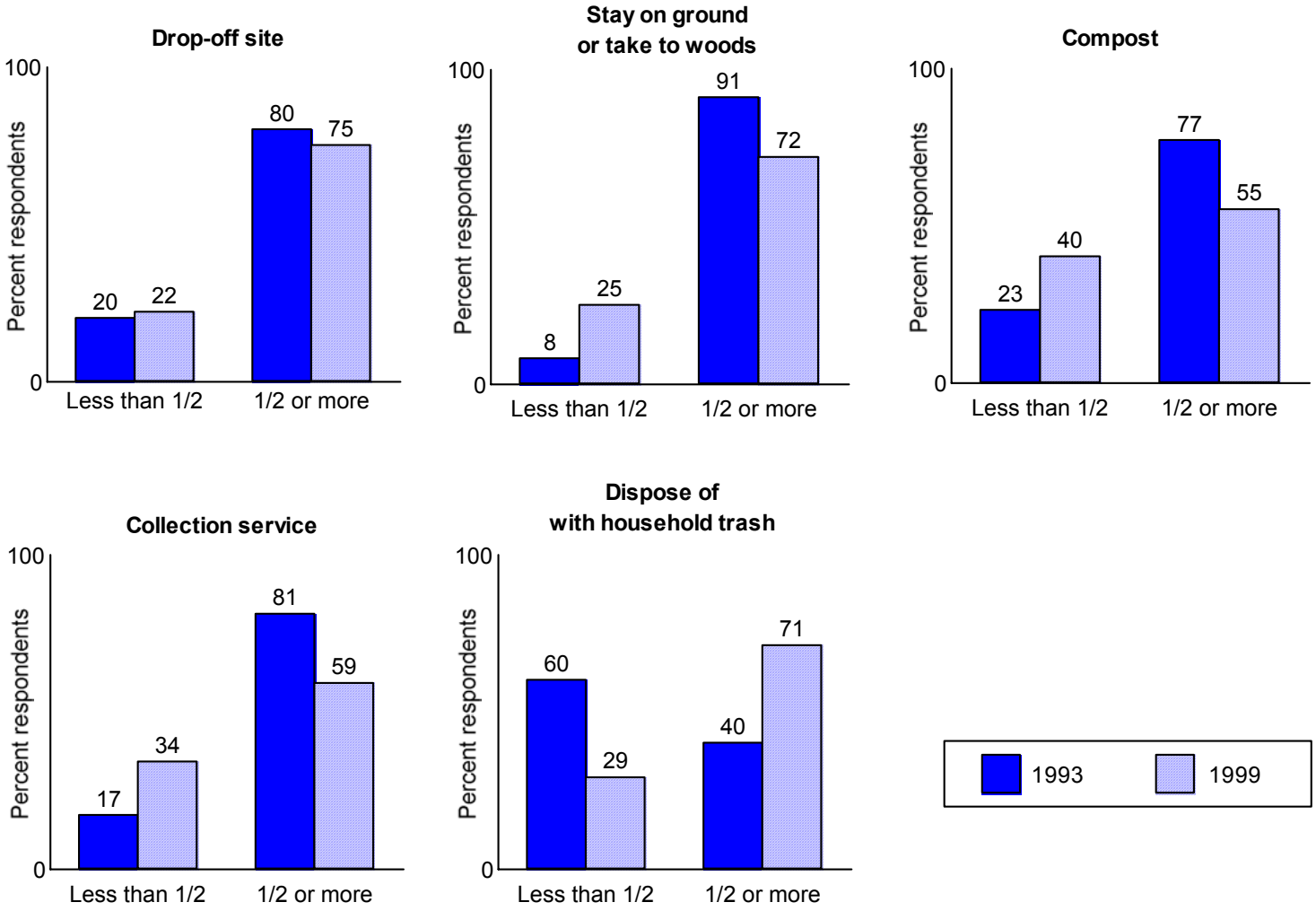
- The number of respondents who report that they let one-half or more of their grass clippings stay on the ground, or take them to the woods, has declined 19 percentage points since 1993 (91% vs. 72%). Similarly, the number who say they compost one-half or more of their grass clippings dropped over the past six years (77% vs. 55%). Both of these decreases are statistically significant at $p \leq .01$.
- Once again, the length of time residents have been handling their grass clippings on site may account for this finding.
  - ⇒ Six in ten (62%) of those who have been letting their grass clippings stay on the lawn (or taking them to the woods) for three years or less handle one-half or more of their leaves in this fashion. In contrast, 69% of those who began treating their grass clippings this way four to seven years ago, and an identical number (69%) of those who started eight or more years ago, handle one-half or more of the clippings in this fashion.
  - ⇒ The results are similar for composting. Four in ten (38%) of those who have been composting their grass clippings for three years or less compost one-half or more of their grass clippings, compared with 57% of those who began composting grass clippings four to seven years ago and 63% of those who have been composting grass clippings for eight or more years.
- The number of respondents who handle one-half or more of their grass clippings by taking them to a drop-off site (80% vs. 75%), or having them picked up by a collection service (81% vs. 59%), have also declined. The decrease in collection service is a statistically significant difference at $p \leq .01$.

- In contrast, the number of residents who handle one-half or more of their grass clippings by putting them out with the household trash has increased 31 percentage points since 1993 (40% vs. 71%).

  ⇒ However, since a small number of residents report putting grass clippings out with the household trash (less than 20), this difference is not statistically significant.

  ⇒ Further, it is not surprising that the small number of residents who do throw their grass out with the trash handle a large proportion of their grass clippings in this manner. It appears that those who throw grass clippings away are a small, hard-core group, with 55% saying they handle all of their grass clippings this way.

Amount of Grass Clippings Handled by Each Method: 1993 vs. 1999



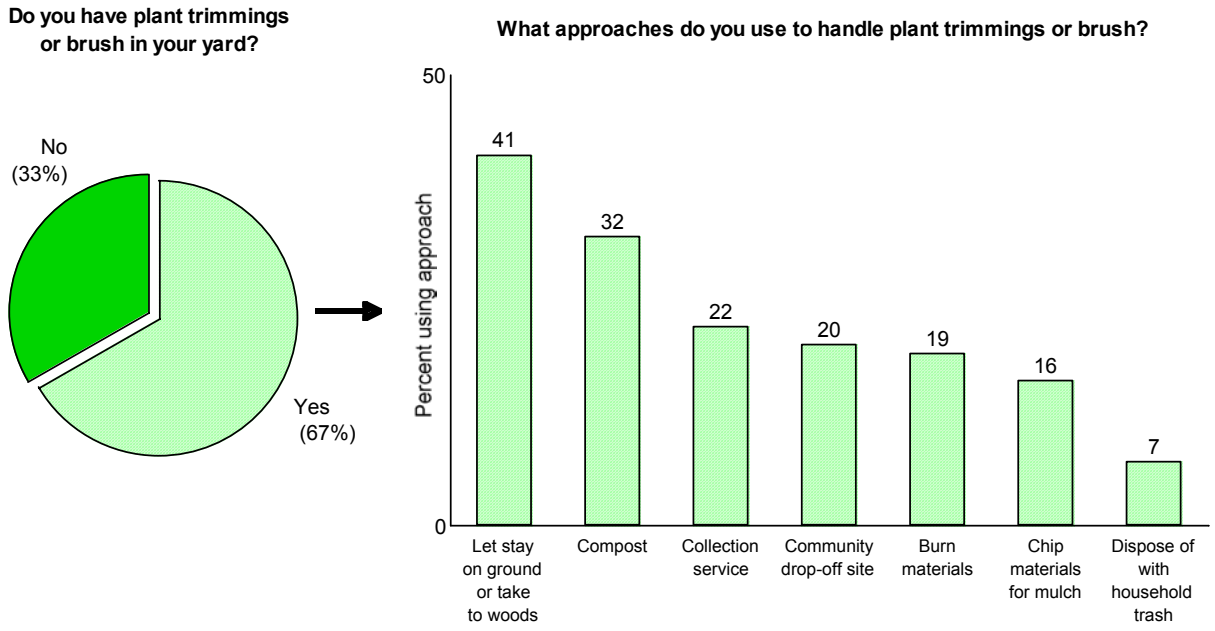
Plant Trimmings or Brush

- Massachusetts residents generated an estimated 46,926 tons of plant trimmings or brush in 1998.

  ⇒ Of this total, 30% is diverted on site, an increase of one percentage point over 1992 (29%).

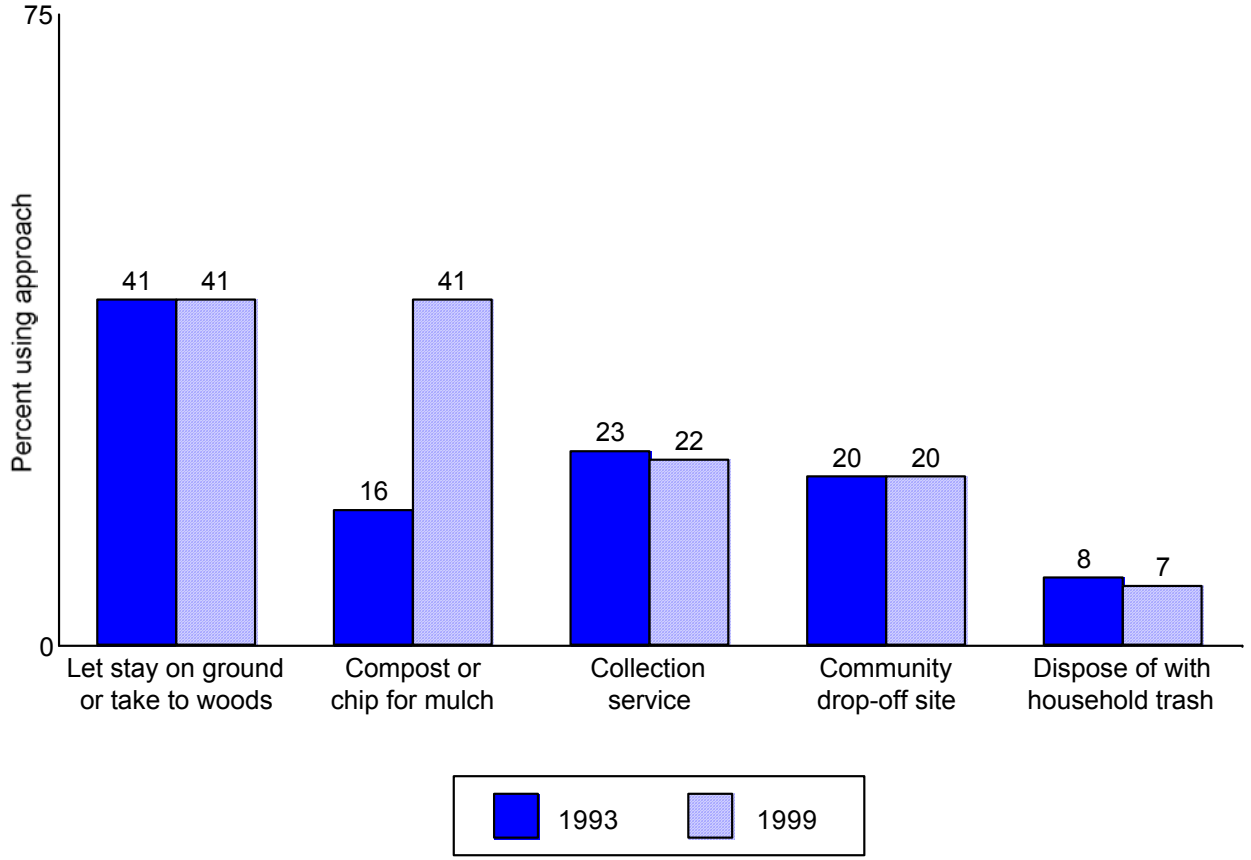
- Two-thirds (66%) of respondents report that they have plant trimmings or brush in their yard. Four in ten (41%) of this group either let the plant trimmings or brush stay on the ground or take them to the woods. In addition, one-third (32%) of these respondents compost the materials, and a lesser number chip (16%) or burn (19%) the material.

Treatment of Plant Trimmings or Brush



- The number of residents who compost plant trimmings or brush is up 25 percentage points over 1993 (16% vs. 41%; a statistically significant difference at $p \leq .01$).
- In contrast, the number of residents who treat plant trimmings or brush in any other manner is nearly identical to that reported six years ago.

Treatment of Plant Trimmings and Brush: 1993 vs. 1999



- Among those who let the plant trimmings or brush stay on the ground or take them to the woods, half (54%) treat either all (46%) or more than three-fourths (8%) of the materials in this manner.

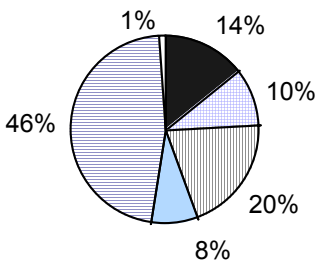
  ⇒ A lesser number (20%) allow one-half to three-fourths of these materials to stay on the ground or take them to the woods. One in ten (10%) treat one-fourth to one-half of their plant trimmings and brush in this fashion, and one in eight (14%) handle less than one-fourth of the material in this manner.

- In contrast, three in ten (29%) of those who compost plant trimmings or brush report that they compost either all (17%) or more than three-fourths (12%) of the materials. Meanwhile, half of those who compost this material (50%) report composting only one-fourth to one-half (25%) or less than one-fourth (25%) of the plant trimmings and brush in their yard.

- Among those who chip the materials for mulch, one in eight (13%) chip either all (2%) or more than three-fourths (11%) of the plant trimmings or brush in their yard. Conversely, seven in ten (72%) chip less than one-fourth (38%) or one-fourth to one-half (34%) of this material.

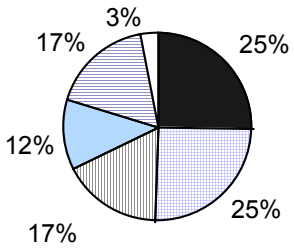
Amount of Plant Trimmings or Brush Handled by Each Method: 1999

Leave on ground or take to woods



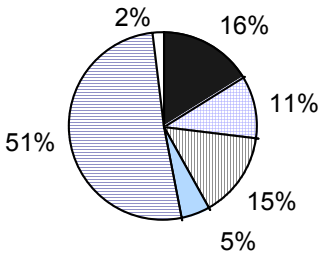
Percent who leave amount on ground or take to woods

Compost



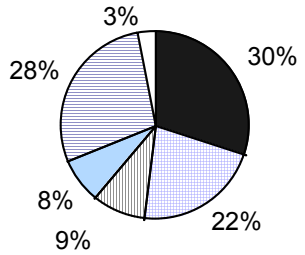
Percent who compost amount of brush or plant trimmings

Collection service



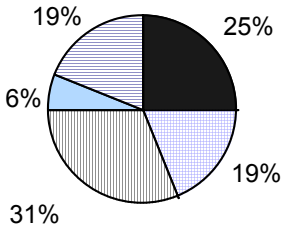
Percent who have amount picked up

Burn materials



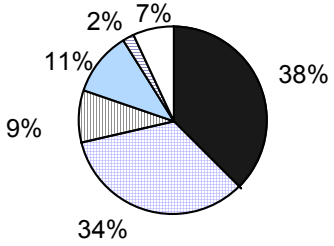
Percent who burn amount of brush or plant trimmings

Community drop-off



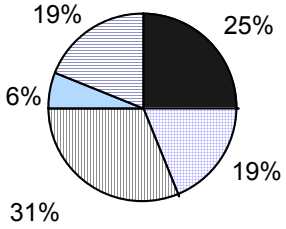
Percent who take amount to drop-off site

Chip for mulch



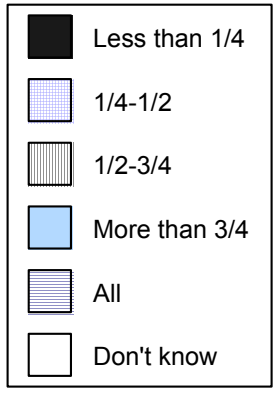
Percent who chip amount for mulch

Dispose with trash



Percent who dispose of amount with trash

Proportion of material handled (clockwise)



As with other forms of yard waste, the portion of trimmings and brush managed on site has decreased since 1993.

- The number of respondents who report leaving half or more of their plant trimmings or brush on the ground (or taking them to the woods) has declined 13 percentage points since 1993, a statistically significant difference at $p \leq .01$.
- Meanwhile, the number who compost or chip half or more of their plant trimmings or brush is down 31 percentage points from six years ago, a statistically significant difference at $p \leq .05$.

The decline in the amount of plant trimmings or brush residents compost or chip may reflect the increase in the number of residents who recently began composting the material.

- One-fourth (25%) of those who began composting plant trimmings or brush within the past three years compost one-half or more of the materials, compared with 35% of those who began four to seven years ago and 60% of those who have been composting the material for eight years or more.

On the other hand, the results are less clear for those who leave plant trimmings or brush on the ground or take them to the woods.

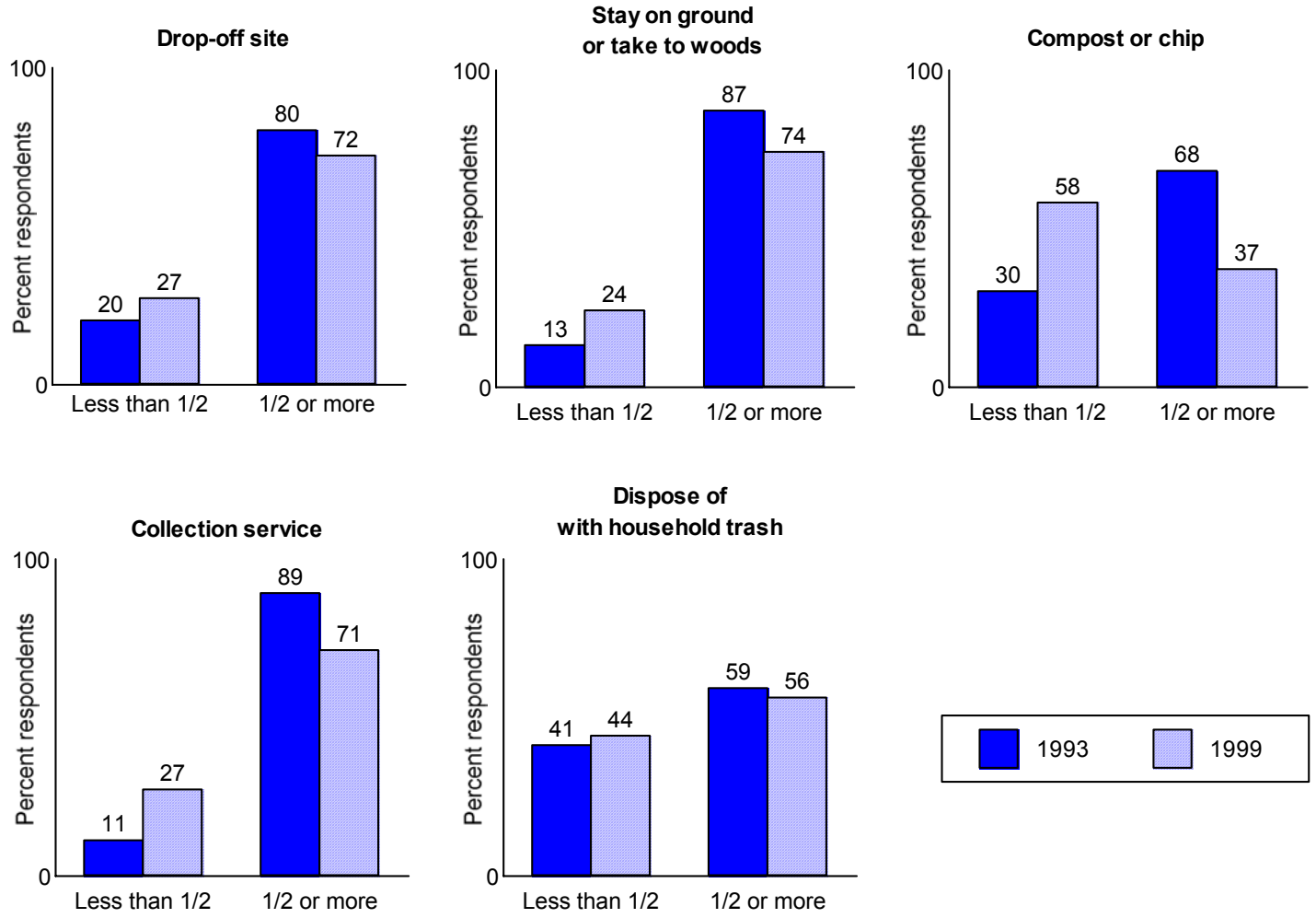
- Three-fourths (75%) of residents who began diverting plant trimmings or brush within the past three years handle one-half or more of the materials in this fashion, compared with 74% of those who have been diverting plant trimmings or brush four to seven years and 76% of those who have been diverting the materials eight years or more.

- The number of residents who take one-half or more of their plant trimmings or brush to a drop-off site (80% vs. 72%), or dispose of one-half or more of the materials with the household trash (59% vs. 56%) has also declined since 1993.

  ⇒ Massachusetts residents disposed of an estimated 2,222 tons of plant trimmings or brush with household trash in 1998.

- The number of residents who have one-half or more of the materials picked up by a collection service has decreased 18 percentage points (89% vs. 71%; a statistically significant difference at $p \leq .01$).

Amount of Plant Trimmings or Brush Handled by Each Method: 1993 vs. 1999



V. Food Waste

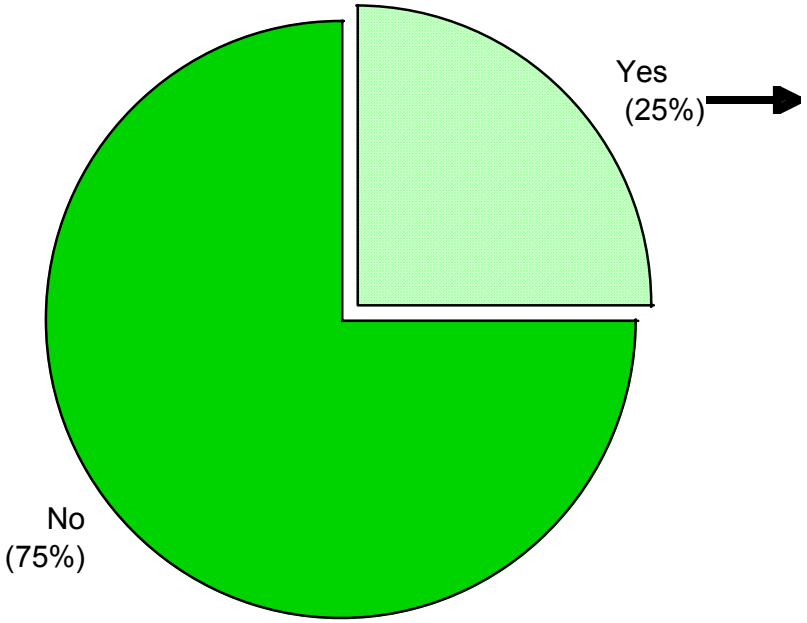
In addition to yard waste, this research asked respondents a detailed series of questions about how they handle food waste. This section describes the number of residents who compost food waste, the amount of food waste they compost, and it discusses the main reasons respondents cite for both composting and not composting food waste. The chapter also discusses the major determinants of the likelihood that residents will compost food waste.

Level of Participation

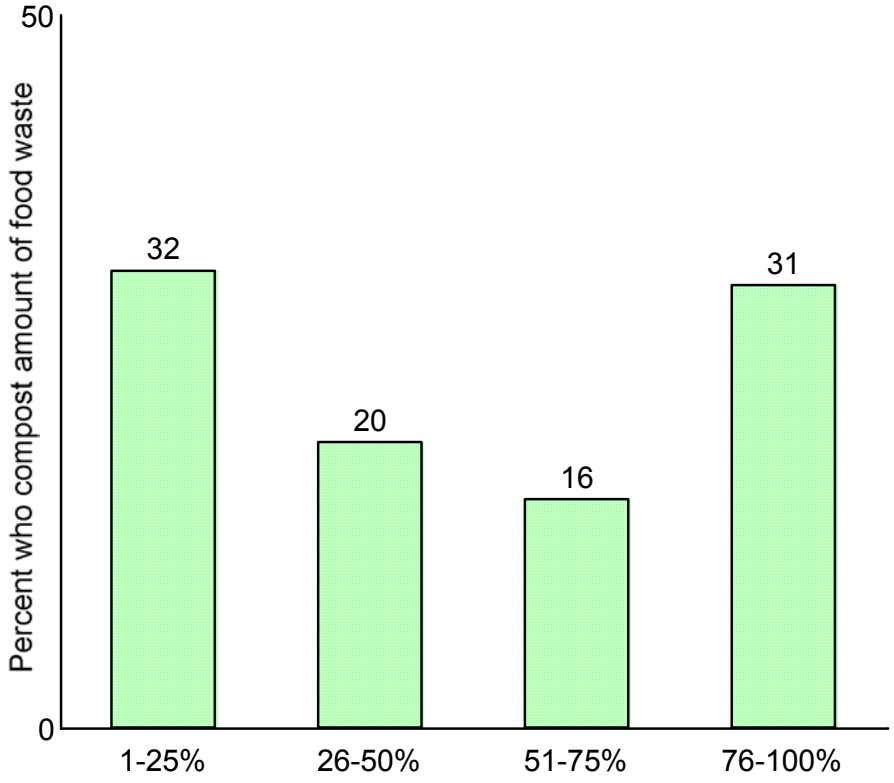
- Massachusetts residential households generated an estimated 706,971 tons of food waste in 1998. Of this total amount of food waste, approximately 11% (76,241 tons) is composted.
- One-fourth (25%) of all respondents report that they compost at least some of their household food waste, up eight percentage points since 1993 (17%).
- The reasons residents cite for beginning to compost food waste are similar to the reasons people say they started composting yard waste.
- Overall, residents report composting an average of 54.7% of their food waste.
- About one-half (52%) of those who compost their food waste estimate they compost less than one-half of their food waste.

Participation in Food-waste Composting and Amount Composted

Do you compost any of the food waste your household generates?



What percentage do you compost?



Reasons for Composting

- Four in ten (44%) residents who compost food waste say they began composting food because it is good for their garden (20%), enriches the soil (15%), or naturally recycles resources (9%).
- One in ten (10%) residents began composting food waste because their friends or relatives did it. Smaller portions began composting food because it adds to their compost pile (8%), is good for the environment in general (9%), or because composting either saves space at landfills or creates less trash (9%).

Reasons for Composting Food Waste (Total Responses)

Reason	***Percent Who Mention***
Good for the garden	20
Enriches the soil	15
Friends/Relatives did it	10
General positive reason	10
Recycling natural resources	9
Good for the environment	9
Saves landfill space/trash	9
Adds to compost pile	8

Impact of PAYT

- Those who live in PAYT communities are much more likely to report that they compost some of their food waste than are those who do not live in these communities (41% vs. 25%; difference is statistically significant at $p<.05$).

  ⇒ In terms of the amount of food waste that they compost, however, residents from PAYT communities do not compost a greater portion of their food waste than those residing in communities without a PAYT program.

- Availability of space provides one possible explanation for why residents from PAYT communities are more likely to compost food waste than those who do not reside in PAYT towns.

  ⇒ Residents from PAYT communities report larger yard sizes than those who do not reside in these towns: two-thirds (67%) of residents from PAYT communities report that their yard is more than a quarter of an acre in size, compared with half (55%) of those who do not live in a PAYT community.

  ⇒ Further, three-fourths (76%) of residents who live in a PAYT community reside in the western or central part of the state (413 and 978 area codes), and residents who live in these area codes report the largest yard sizes.

- Those who reside in a PAYT community are more likely to say that one of the major benefits of composting food waste is that it either enriches the soil or recycles natural resources (45% vs. 36%; difference is significant at $p\leq.05$).

- However, residents in PAYT towns are no more likely than others to mention that composting food waste saves landfill space and reduces trash (17% each).

  ⇒ The solid waste management benefits of composting do not appear to be top-of-mind for respondents in PAYT programs.

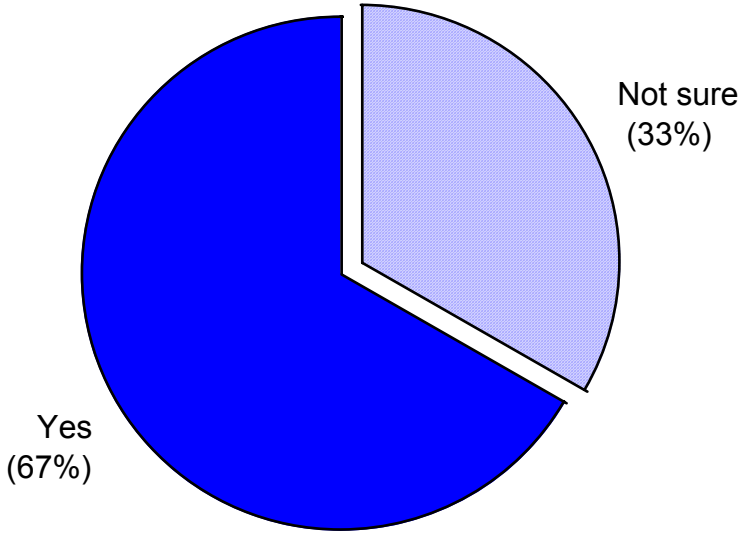
Program Potential

According to the EPA Source Reduction Manual, an average of 72% of food waste can be composted. Therefore, these results suggest that a significant portion (30%-40%) of households that compost food waste could compost a greater portion of their food than they do now.

- Two-thirds (67%) of respondents believe they currently compost all of the food waste in their household that it is possible to compost.
- Among those who believe they are not composting all of the food waste they possibly could (33%), respondents most frequently state that they are not composting more food waste because they do not have the time (34%) or that composting food waste attracts animals (34%). Some respondents (10%) also mention that they do not have enough space in their compost pile to compost more of their food waste.
- Only 41% of respondents who compost food waste use an enclosed compost bin. However, as discussed later in this section, residents who use compost bins appear to compost a greater variety and volume of their food waste than do those who compost food waste in an open pile. Consequently, continuing to make enclosed compost bins available, and encouraging their use, may result in an increase in the amount of food waste Massachusetts residents compost.

Reasons for Not Composting More Food Waste

In your opinion, are you composting all of your food waste that can be composted?



Why aren't you composting more of your food waste?

Convenience/No time	34%
Attracts animals	34%
Not enough space	10%
Too much food waste for amount of yard waste	3%
(Other)	11%
(Don't know)	7%

Compost Bins

- Four in ten (44%) residents state that they compost their food waste in an open pile, and a similar number report that they compost in a bin (41%).
- Composting food waste in a bin appears to contribute to residents composting a larger proportion of their food waste. Whereas 51% of those who compost in a bin report that they compost half or more of their food waste, 42% of those who compost in an open pile compost half or more of the food waste their household generates (57% of those who compost in a bin *and* a pile compost half or more of their food waste).

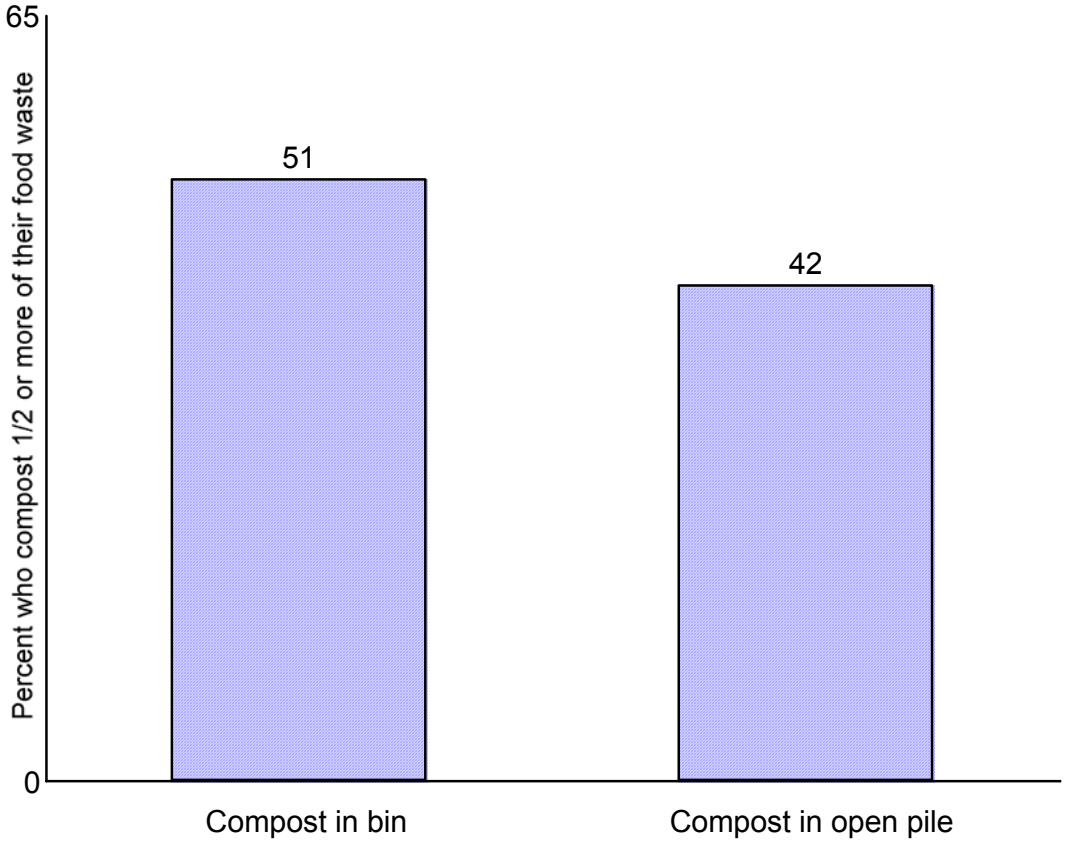
  ⇒ Since a bin offers greater protection against rodents than does an open pile, this finding suggests that residents may put a greater variety and volume of food waste types into a compost bin than they do into an open pile.

- Among those who compost their food waste in a bin, the majority (65%) have only one compost bin, while one-fourth (24%) possess two bins. Fewer (11%) respondents have either three (9%) or more than three (2%) compost bins.
- The number of respondents who have a homemade compost bin (46%) is about the same as those who say they purchased their bin (42%). One in twenty (4%) residents have a worm bin.
- Nearly three-fourths (73%) of those who purchased their compost bin received it through their town. Among this group, respondents most often say they heard about the compost bin program through the newspaper (34%), followed by a brochure at town hall (23%), a mailing they received at their home (8%), or a friend, relative, or neighbor (8%).

  ⇒ The town compost bin distribution program appears to have an impact upon increasing the number of residents who compost their food waste. Among those who purchased their bin through the town, half (47%) did not compost any food waste before they received the bin.

- With respect to questions regarding compost bins, respondents living in PAYT communities respond in a fashion similar to that of those who do not reside in one of these communities.

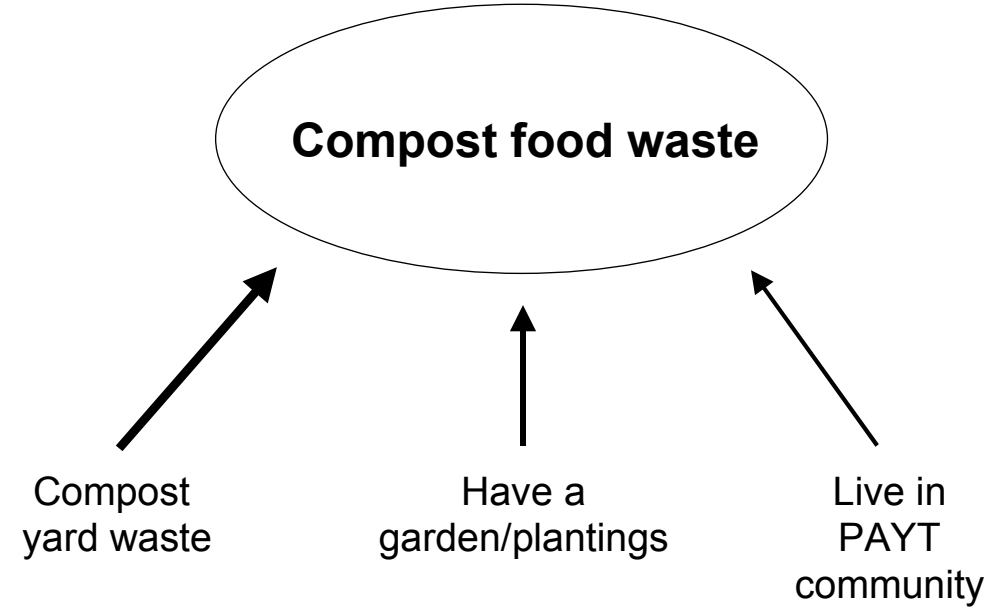
Impact of Composting in Bins vs. Open Pile on Amount Composted



Determinants of Food-waste Composting

- The figure below illustrates the key determinants of food-waste composting. It summarizes the results of a multivariate analysis of possible influences on the likelihood that residents will compost food waste.[6] The most important determinant of food-waste composting is whether or not the residents compost yard waste, followed by whether or not they have a garden or live in a PAYT community.

Key Predictors of the Likelihood Residents Will Compost Food Waste



[6] Method: logistic regression. Dependent variable: response to question, "Do you compost any of the food waste your household generates?" Independent variables: age, education, homeownership, existence of a bin/brochure program in town, type of yard-waste collection service in town, whether respondent has a garden or plantings, size of yard, whether resident composts yard waste, whether respondent lives in a PAYT community, and the region of the state in which the respondent lives (using area code). All variables in figure above are significant $p \leq .05$.

- Specifically, residents who compost yard waste are 20 times more likely to compost food waste than are those who do not compost yard waste. This result is not surprising. Since those who compost yard waste already compost some waste materials (yard waste), they are more likely to begin composting other household waste (food).

  ⇒ Similarly, residents who have a garden or plantings at their home are three times more likely to compost food waste than are those who do not have a garden or plantings. As discussed earlier, many respondents who compost food waste say they do so because it is good for their garden and the soil. This finding is consistent with these statements.

  ⇒ In addition, residents from PAYT communities are two-and-one-half times as likely to compost food waste as are those who do not live in one of these communities.

Likelihood that Residents in Each Category Will Compost Food Waste

Category	*Amount More Likely to Compost Food Waste than Those Not in Category*
Compost yard waste	20 times
Have a garden or plantings	3 times
Live in PAYT community	2.5 times

⇒ These findings suggest that DEP can increase food-waste composting by targeting its efforts on people who already compost yard waste, have gardens, or live in a PAYT community.

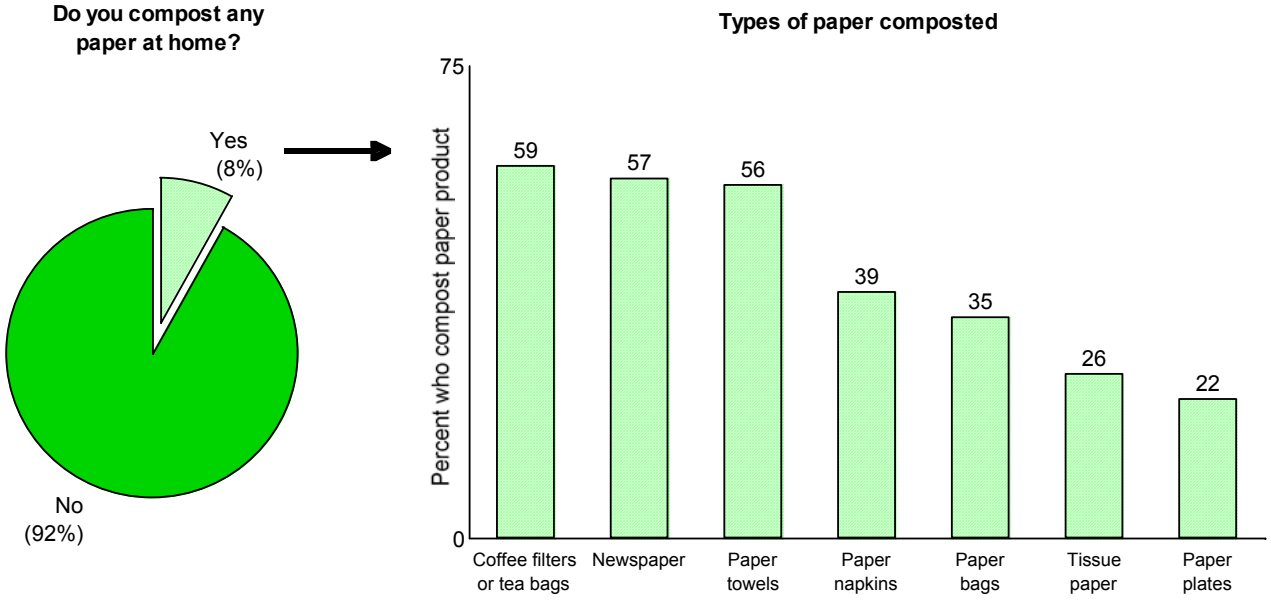
VI. Paper Waste

This study asked those respondents who compost either yard or food waste a series of questions about paper waste. The survey asked whether residents compost paper waste at all, as well as what kinds of paper residents compost and how much of their paper waste they compost.

Composting Paper Waste

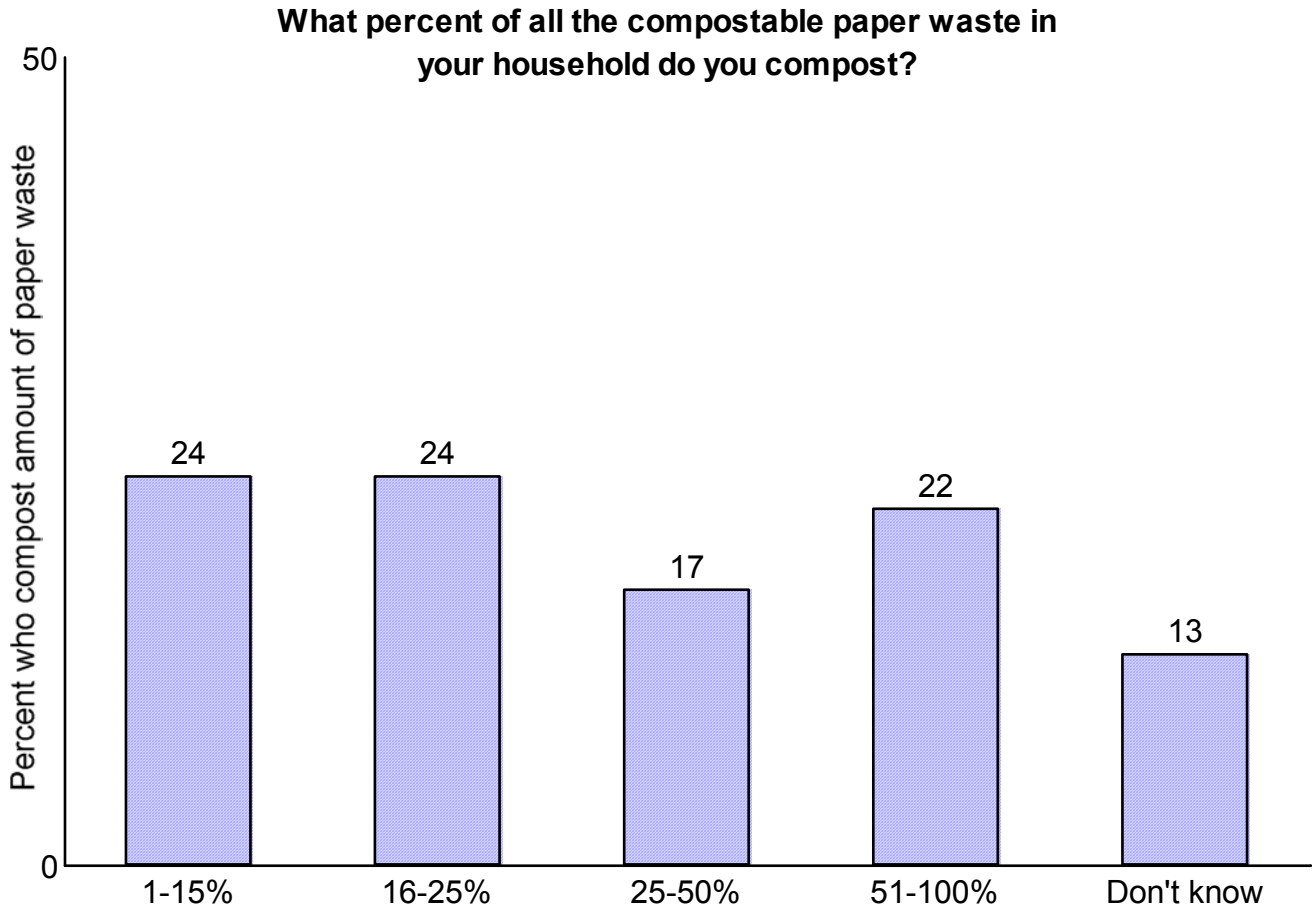
- Among those who already compost yard or food waste, one in ten (8%) say they also compost paper waste at home (4% of all Massachusetts households).

Composting of Paper Waste



- Half (48%) of those who compost paper waste state that they compost one-fourth of their paper waste or less, while 17% say they compost one-fourth to one-half of their paper waste. Two in ten (22%) respondents compost one-half or more of the compostable paper in their household.

Amount of Paper Waste Composted



Lack of knowledge about paper composting seems to be a primary reason more people don't do it.

⇒ 23% say they *didn't know* paper could be composted and 12% say they *don't know how* to compost paper waste.

⇒ More than one in four say they don't compost paper because *they recycle paper instead* (27%).

⇒ Fewer respondents report that they either have *too much paper to compost* (15%), are *too busy to compost paper* (8%), or *do not have space for a compost bin* (5%).

- The number of residents from PAYT communities who compost paper is identical to that of those who do not reside in one of these communities (4% in both).

VII. Outreach Programs

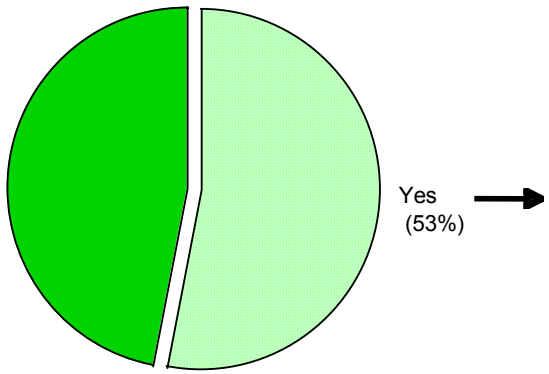
The DEP conducts programs designed to increase the level of home composting in the state. This section of the report describes the level of awareness, and the impact, of DEP outreach efforts.

Awareness and Effect of Composting Information

- Half (53%) of all respondents who compost recall seeing or hearing information about composting. Most report that they heard about composting in the newspaper (30%), in books or magazines (19%), or on television (14%). As a top-of-mind first mention, 7% say they recall seeing the information from their town or in the mail from the DEP (11% total responses).

Top-of-Mind Recall of Information about Composting

Do you recall seeing or hearing any information about composting?*



Where did you see or hear this information? (First response)

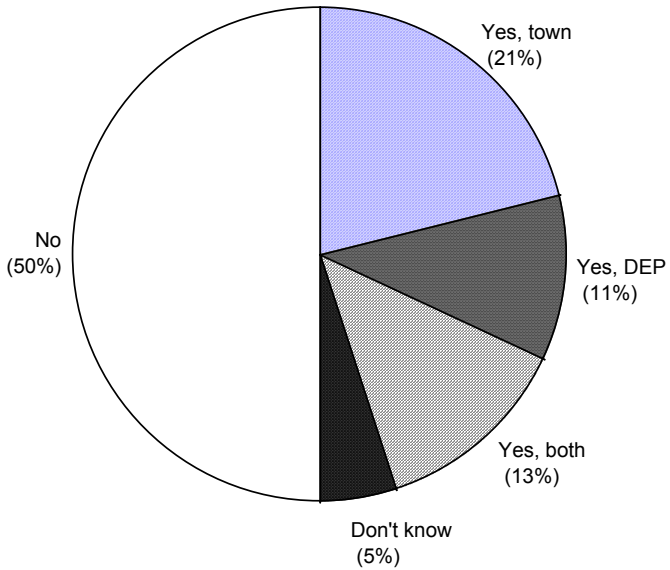
Newspaper	30%
Books/magazines	19%
Television	14%
Brochure at town hall	7%
Nursery or garden store	4%
In the mail	4%
Friend/neighbor/relative	3%
General literature	3%
(Don't remember)	4%
(Other)	11%

* Asked of 54% who compost some yard material or food or paper waste

- When asked specifically if they recall seeing the information from their town or the DEP, however, 21% say they recall seeing the information from their town, 11% from the DEP, and 13% received the information from both.
- Including <u>both</u> top-of-mind and prompted recall, a total of 45% of Massachusetts residents that compost say they've seen or heard composting information from the town or DEP.

Prompted Recall of Composting Information from the Town or DEP

Have you ever seen or heard any information about composting from your town or the state DEP?*

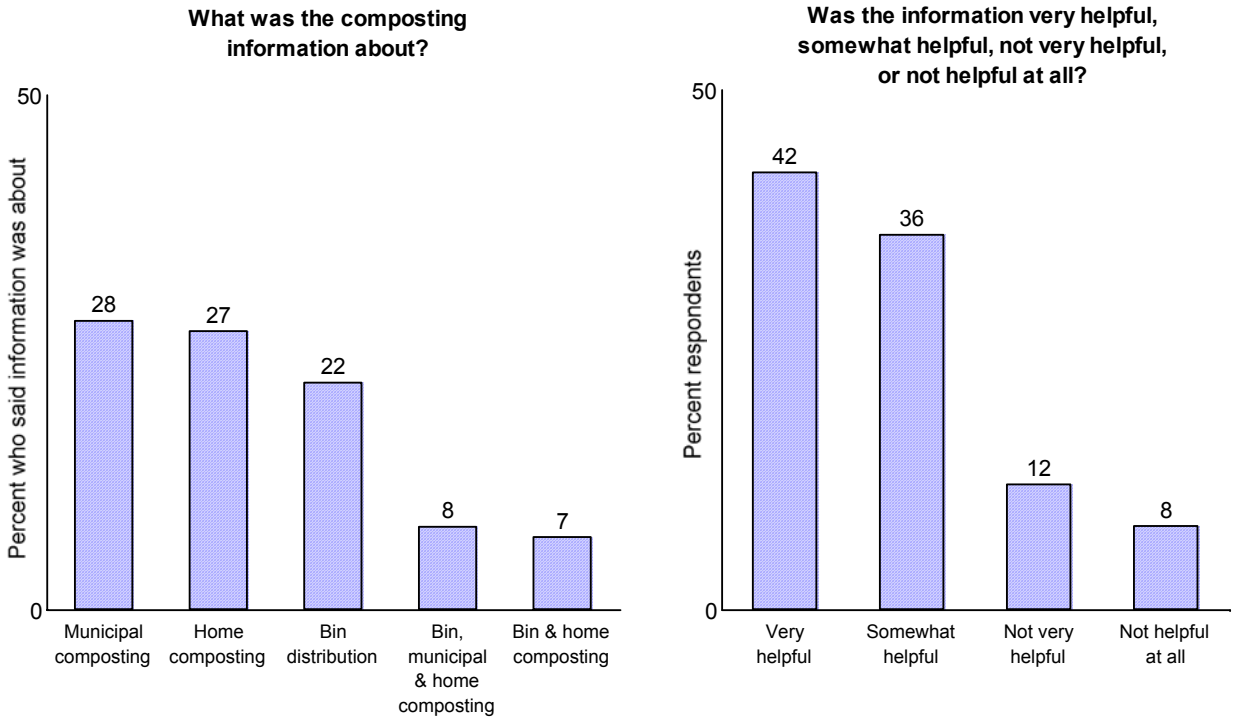


* Asked of 89% who did not mention hearing information through the town or Mass. DEP

- Among those who saw information about composting from either their town or the Massachusetts DEP, three in ten (28%) say the information was about municipal composting or home composting (27%), while two in ten (22%) report that the information was about a bin distribution program.

  ⇒ The vast majority (78%) of respondents say that the information they received about composting from their town or the Massachusetts DEP was very (42%) or somewhat (36%) helpful.

Helpfulness of the Information Received from Town or DEP



The presence of Massachusetts DEP's home composting brochure and bin distribution programs appears to have a slight impact on the likelihood that residents will compost yard and food waste.

- Residents who live in towns with bin or brochure programs report slightly higher levels of food composting (27% vs. 23%) than those in towns without the programs. The results are somewhat stronger for yard waste (55% vs. 47%).
- The impact of the bin and brochure programs appears somewhat weaker in PAYT communities. Among those living in a PAYT community, 42% of those who live in a town with the program compost food waste, compared with 39% of those who live in PAYT towns that don't have the program. With respect to yard waste, 61% of those living in PAYT towns with the program compost yard waste compared to 58% in PAYT towns without the program.

Survey results suggest that lack of awareness of the bin and brochure programs is one of the reasons residents in towns with programs aren't composting at significantly higher rates than communities without the programs.

- Residents in communities with bin or brochure distribution programs are somewhat more likely to say they recall seeing or hearing any information about composting (57%), compared to residents in communities without the programs (48%). (This difference is not significantly significant, in part because the results are based on fewer than 60 respondents.)
- When asked if they recall any composting information from the DEP or town specifically, 47% of residents in towns with programs say they do, compared to 42% in towns without the programs.

  ⇒ Thus, the survey results suggest that enhancing DEP communications about the existence of composting programs to residents who live in these communities may contribute to an increase in the number of residents who compost.

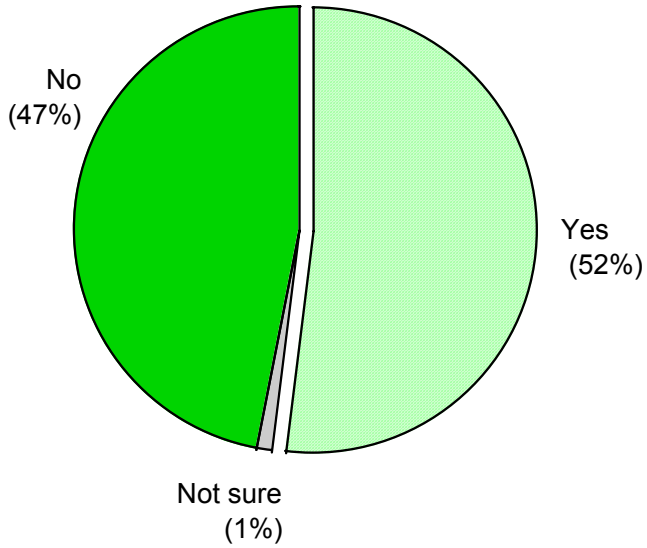
Communications on Grasscycling

- Half (52%) of all respondents recall seeing or hearing some information about "grasscycling," described in the survey as the process of recycling grass clippings back into the lawn.

  ⇒ Newspaper (18%) is the most frequently cited source of the grasscycling information, followed by television (17%), books/magazines (12%), or hearing about it from a friend, neighbor, or relative (10%).

Recall of Information on Recycling Grass Clippings

Do you recall seeing or hearing any information about recycling your grass clippings back into your lawn?



Where did you see or hear this information? (First response)

Newspaper	18%
Television	17%
Books/magazines	12%
Friend/neighbor/relative	10%
Lawnmower dealer	8%
Nursery or garden store	4%
Hardware store	4%
(Don't remember)	17%
(Other)	6%

VIII. Increasing On-site Diversion: Obstacles and Opportunities

The results of this research suggest some obstacles confronting the DEP with respect to increasing the level of on-site diversion and composting of organic waste practiced in the state. The study also indicates possible opportunities for increasing on-site diversion. This section of the report discusses these obstacles and opportunities with respect to yard, food, and paper waste.

Yard Waste

- About half (50%) of Massachusetts residents report that they compost some of their yard waste. However, one-fourth (23%) say they are likely to start composting in the future.

  ⇒ A greater number of those from demographic groups who report the highest levels of composting--college graduates and respondents 36 to 55 years of age--also say they are likely to begin composting in the future.

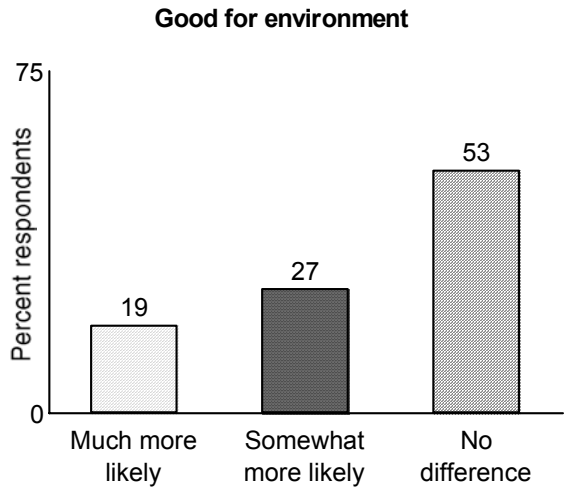
  ⇒ Most of this segment, however, is currently practicing another type of on-site diversion. Currently, those who say they are likely to begin composting most often let their leaves (40%) and brush (60%) stay on the ground or take them to the woods.

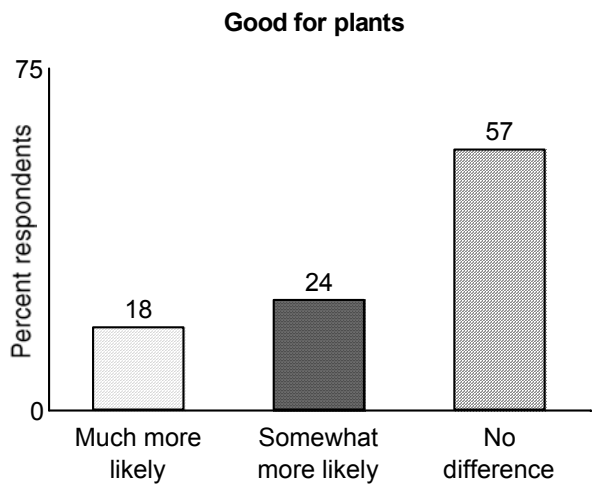
  ⇒ In addition, half (50%) of this group leave their grass clippings on the ground, while 40% take their grass clippings to the woods. (The number of respondents in these groups is small, and results must be interpreted with caution.)

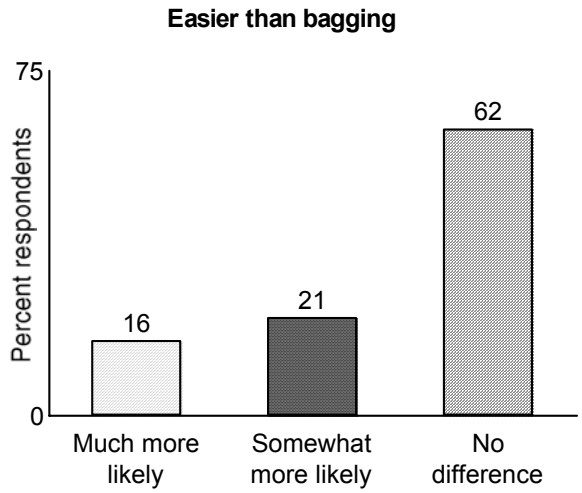
  ⇒ These results suggest that while it may be possible to increase participation in composting, these efforts will divert materials from other on-site diversion practices and probably not noticeably increase overall levels of on-site diversion.

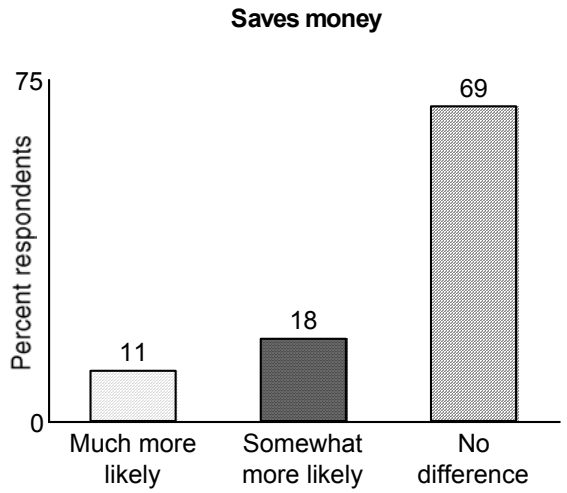
- All the messages tested in the survey indicate they would have some impact on the likelihood that respondents who do not compost yard waste will begin composting in the future.
- Communicating information about the environmental and horticultural benefits of composting appears to have the strongest influence among those who do not currently compost yard waste.
  - ⇒ Half (46%) of those who do not compost yard waste say knowing that composting is good for the environment makes them very (19%) or somewhat (27%) more likely to start composting in the future.
  - ⇒ A similar number (42%) say knowing that composting is good for plants makes them very (18%) or somewhat (24%) more likely to start composting in the future.
- Messages tested in the survey about the convenience or economics have some impact on the likelihood that residents who do not compost yard waste will begin composting in the future.
  - ⇒ Nearly four in ten (37%) residents say learning that composting is easier than bagging makes them much or somewhat more likely to compost, and three in ten (29%) say that learning that composting *saves money* makes them much or somewhat more likely to compost. The results are similar among those who say the main reason they do not compost yard waste is that they are too busy or composting is too much work.

Effect of Information on the Likelihood Residents Will Compost Yard Waste









- One in seven (14%) residents also report that the main reason they do not compost yard waste is that they don't know how. Further, with top-of-mind mention, one in six (17%) residents say the main reason they do compost yard waste is that it is an easy means of disposal.

  ⇒ Although a relatively small proportion of respondents, these results suggest that the possibility exists for attracting some residents to composting by simply communicating about how to compost yard waste and emphasizing the ease with which residents can begin composting.

- Awareness of the ban on putting yard-waste materials in the state's landfills is low (16%). Nevertheless, a greater number of those who are aware of the ban (90%) report that they divert at least some of their yard waste than do those who are unaware of the ban (81%). Consequently, increasing awareness of the ban on the disposal of yard waste in Massachusetts landfills may contribute to higher rates of on-site diversion.

  ⇒ Younger respondents (under 36 years of age), as well as those in the western part of the state (413 area code) report slightly lower levels of awareness of the ban on the disposal of yard waste in the state's landfills. However, sample sizes are very small in these groups, and it is necessary to use caution when interpreting the results.

- Most of those who recall seeing information about composting saw the information in the newspaper. Since college-educated respondents--who report some of the highest levels of composting--are also more likely to read the newspaper than are respondents with lower education levels, the DEP should continue to use newspaper articles and ads for communicating information about composting to this group of residents.

- The Massachusetts DEP could also consider targeting first-time and/or young homebuyers with its communications about the benefits of on-site diversion and the composting of yard waste. Younger residents practice on-site diversion at a lower rate than older residents, and they thus represent a group where room for increasing the number who practice on-site diversion exists.

⇒ Homeowners and college graduates report higher levels of diversion than do renters or those with lesser levels of education. Since first-time homebuyers are likely to be both younger (35 years of age and under) and college graduates, the DEP could target its communications to first-time homebuyers through direct mailings, as well as developing relationships with realtors to include DEP materials in information packets they distribute to homebuyers.

Food Waste

- The most important determinant of food-waste composting is whether or not respondents already compost yard waste. In addition, those with plants or gardens, as well as those living in PAYT communities, are more likely than others to compost food waste.

  ⇒ Consequently, the DEP could consider bundling communications about yard-waste composting with those about composting food waste.

  ⇒ Targeting places where those who have plants or a garden are likely to frequent, such as garden stores and plant nurseries, may also help reach an audience open to the prospect of composting food waste.

  ⇒ The DEP should also target its communications to communities that have PAYT disposal systems, many of which are located in the western and central parts of the state (413 and 978 area codes).

- Residents who compost food waste say the main reasons they compost are that composting is good for their garden or enriches the soil in general. These responses are similar to those mentioned by those who compost yard waste.

  ⇒ Therefore, the Massachusetts DEP should emphasize the horticultural benefits of food- and yard-waste composting while encouraging both types.

<u>Messages tested</u>

- Of the communications tested in the survey, the messages that composting food waste makes household trash less likely to smell and keeps food waste out of landfills and incinerators have a somewhat stronger impact on the likelihood residents will start composting food waste.

⇒ As shown in the following charts, 35% of residents say that knowing *composting makes household trash less likely to smell* makes them very or somewhat more likely to start composting food waste. Thirty-four percent say that knowing that *food-waste composting diverts waste from landfills and incinerators* makes them very or somewhat more likely to compost food waste.

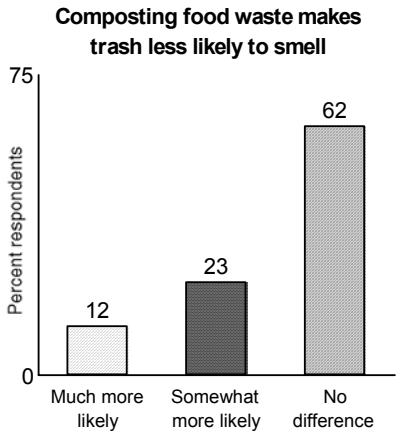
⇒ Approximately three in ten say the other messages tested make them somewhat or very likely to compost food waste, including *composting food waste saves money* (29%), *rodent-resistant bins are available for less than $25* (29%), and *composting food waste makes better compost than yard waste alone* (30%).

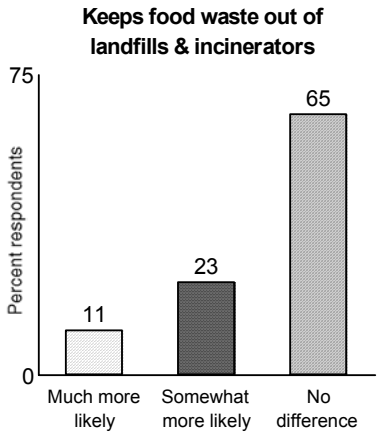
- All of the food-waste composting messages tested in the survey appear to have some positive impact on the likelihood that residents will begin composting in the future. The impact of the messages on actual behavior, however, is likely to be below the levels residents stated in the survey (29% to 35% likelihood) because stated intentions rarely translate fully into actual behavior.

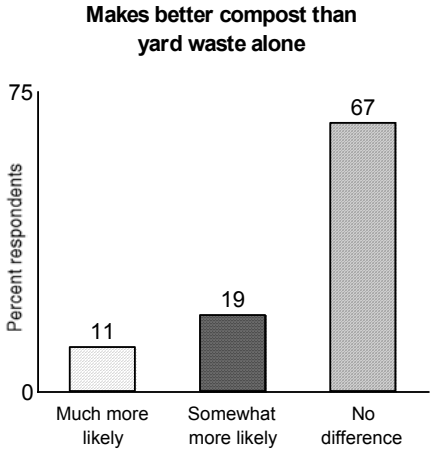
  ⇒ The results are similar for communications aimed at reducing the use of garbage disposals, with the knowledge that composting food waste instead of putting it in the garbage disposal saves water demonstrating the strongest appeal (41% very or somewhat more likely to compost). Reducing waste in septic systems had almost as much appeal (37%) to people with garbage disposals.

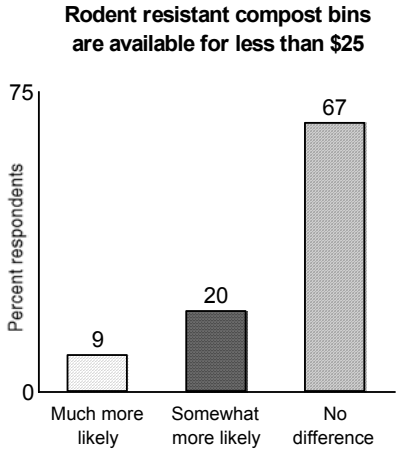
- These results indicate there is potential to influence people who use garbage disposals to start composting food waste instead.

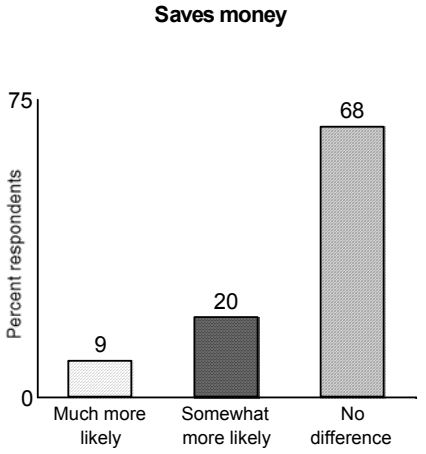
Effect of Information on Likelihood Residents Will Compost Food Waste



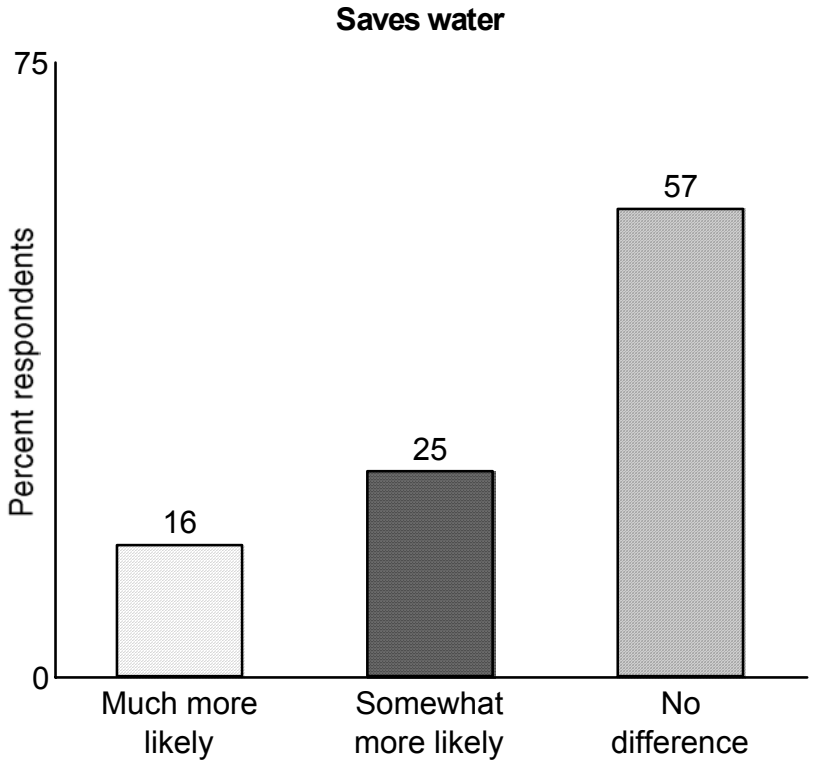


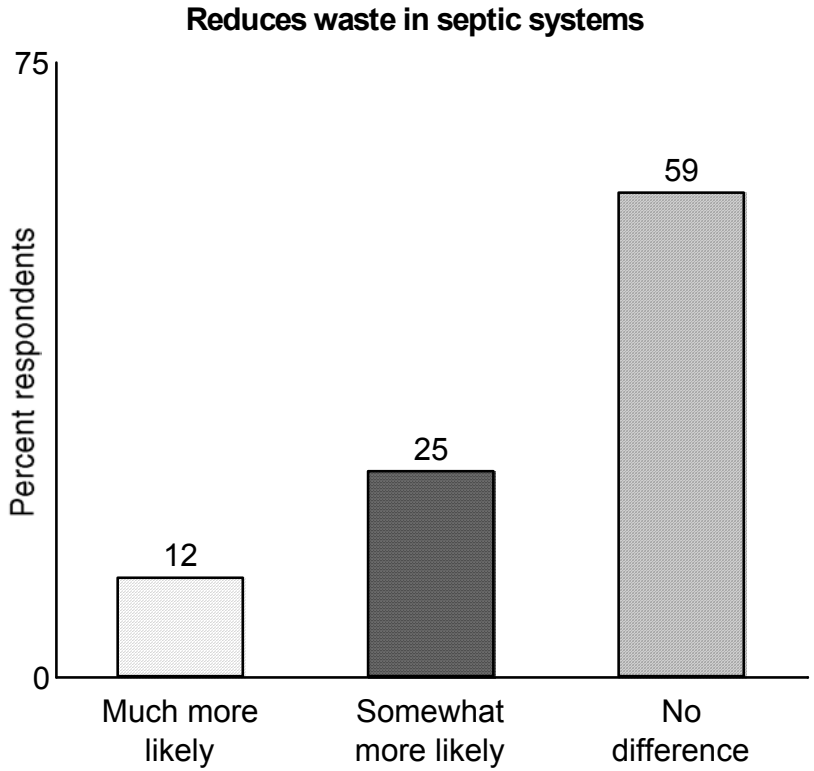






Effect of Information on Likelihood Residents Will Compost Food Waste Rather than Use a Garbage Disposal*





* Questions asked of 47% who have a garbage disposal in their sink

- The bin and brochure distribution programs appear to have an effect on the number of residents who compost food waste. Nearly one-half (47%) of those who report that they purchased their compost bin, either through their town or the Massachusetts DEP, say they did not compost food waste prior to purchasing the bin.

  ⇒ Since residents most frequently mention that they first heard about the compost bin distribution program in the newspaper, the DEP should continue to promote the program through this medium.

- One of the main obstacles to increasing the number of residents who compost food waste is the belief that composting food attracts pests.

  ⇒ Composting experience does not seem to diminish this concern. This belief is prevalent not only among those who do not currently compost yard waste, but also those who already compost their yard waste.

  ⇒ In the survey, 29% of non-food composters say that knowing rodent-resistant bins are available makes them at least somewhat more likely to compost food waste.

  ⇒ Information about rodent-resistant bins has the same level of effectiveness among people who are specifically concerned about attracting animals. One-fourth (24%) of those who fear attracting rodents report that the existence of rodent-resistant bins makes them more likely to start composting food waste, compared with three in ten (29%) respondents overall.

    ⇒ The survey results suggest that continuing to provide and promote the use of rodent-resistant compost bins is an important tool for influencing residents that don't currently compost food waste.

- Opportunity also exists to increase the amount of food waste being composted among households that already compost food waste.

⇒ One-third of food composters don't think they are composting all of their food waste it is possible to compost.

⇒ On average, food composters estimate they compost more than one-half (54.7%) of their food waste.

- One of the main reasons current food composters don't compost *more* of their food waste is a concern about attracting animals. Because many food composters currently use an open-pile (44%), concerns about food waste attracting animals are probably valid. These results suggest that making rodent-resistant bins available to people who currently compost food waste can increase the type and amount of food waste composted.

Food-waste composting potential

- The majority of food waste is disposed of in household trash or garbage disposals and it is possible to compost a significant portion of this waste.

⇒ Using the tonnages described in the quantification section of this report, an estimated 570,191 tons of food waste are disposed of in the trash (382,720 tons) and garbage disposals (187,471 tons).

- A significant number of residents indicate interest in composting food waste. When exposed to messages about the benefits of food composting, about 30%[7] of residents that don't compost food waste (75% of residents) indicate they are very or somewhat likely to start. Applied to all households, 23% (30% x 75%) of residents say they are somewhat or very likely to start composting food waste. Because stated intentions don't fully translate into actual behavior, it is necessary to "deflate" the survey results to arrive at a more realistic estimate of potential participation. Deflating the survey

[7] This is a rough estimate based on the percent of "very" or "somewhat" likely responses to q85-91 in the survey.

results by a moderate factor of 0.6 results in an estimate of an additional 14% of residents composting food waste[8]. Added to the current 25% of households composting food waste, the increase in participation would result in a total 39% of all households in the state composting food waste.

- If 39% of households in the state compost food waste at the same rate found among current composters, approximately 102,000 tons of food waste would be diverted from the MSW[9]. The increased participation (14% more households composting) would divert an estimated 37,000 tons of additional food waste from the MSW.
- If the percent of food waste composted per person increases (through the distribution of rodent-resistant bins, for example) the potential amount of food waste diverted would increase accordingly.

[8] Deflating survey results to more accurately estimate actual behavior is a standard practice in marketing and market research and is used to project market share and penetration rates for new products and services. Because many factors can influence the extent to which survey results translate into actual behavior, selecting the factor used to "deflate" the results is more "art than science." An adjustment factor of .6 is a moderate (neither conservative nor optimistic) level of deflation.

[9] The new tonnage is estimated by increasing the current tonnage (65,203) by the same rate at which participation is increased (56%). (39% is a 56% increase over the current level of 25% participation.)

Paper Waste

- Four percent of residents report that they compost paper waste. However, the DEP may effectively increase the number of residents who compost paper by simply informing residents that composting paper is possible, as well as by identifying the various types of paper residents can compost.

  ⇒ Three in ten (29%) of those who compost yard or food waste (or both), but do not compost paper waste, report that they *did not know* it was possible to compost the various types of paper cited in the survey (e.g., coffee filters, paper towels, etc.).

- A target audience for increasing paper composting is residents who already compost some material, especially those who compost food waste. Adding paper to a compost bin or pile requires little effort, and those who currently compost food waste are already in the habit of placing household waste in to a compost bin or pile.

- Promoting the use of indoor worm composting bins also represents an opportunity to increase paper waste composting. Worm bins can be a practical composting solution for residents without yards (i.e., those in multi-family dwellings) and they require the use of paper for proper composting (in the absence of leaves or other yard waste).

IX. Quantification of Residential On-site Diversion

This chapter employs the survey results discussed earlier in this report to calculate estimates of the total amount of yard, food, and paper waste generated, and diverted on site, in the state in 1998. The 1993 study also quantified the amount of yard waste generated and diverted on site. This report utilizes much of the earlier methodology, allowing for a direct comparison of the 1999 and 1993 results.[10]

In addition, this chapter quantifies an estimate of the total amount of food and paper waste diverted on site. On-site diversion of food and paper waste was not quantified as part of the 1993 study, so the methodology used for this exercise is new to the 1999 study.

Yard-waste Generation: 1993

- The revised 1993 estimate of yard-waste generation in Massachusetts is 875,972 tons[11]. Since approximately 1,574,707 residential dwellings existed in the state at the time[12], each residential yard produced an average of 1,113 lbs. of yard waste (875,972/1,574,707 = 0.55 tons x 2000 = 1,113 lbs./yard).

  ⇒ The 1999 revision to the 1993 report arrived at this estimate of yard-waste generation (875,972 tons) by dividing the estimated tonnage of yard waste in the MSW by the percent of yard waste (1 minus on-site diversion percentage) in the MSW. This was done separately for each category of yard waste (leaves, grass, and brush).

[10] In this report, organic waste management practices reported in 1999 were used to determine generation and management tonnages for 1998.
[11] Tellus Institute memo entitled "Revised Massachusetts Leaf and Yard Trimming Generation and On-site Diversion," Table 2, p. 2, August 6, 1999.
[12] *1990 U.S. Census*

Yard-waste Generation: 1998 Update

- The number of housing units in the state has increased since 1993. Since the total amount of yard waste generated in Massachusetts grows in proportion to the number of residential dwellings in the state, the amount of yard waste generated in 1998 is greater than it was in 1993. Accordingly, this report utilizes an estimate of the growth in the number of residential dwellings in the state since 1993 to calculate an estimate of the increase in the amount of yard waste generated.
- Specifically, we first estimate the total amount of yard waste generated in 1998 by multiplying the amount of yard waste generated per dwelling in 1993 (1,113 lbs., or 0.55 tons) by the total number of new, privately owned housing starts in the state since 1993 (90,800 total housing starts)[13]. Second, we added this number to the total amount of yard waste generated in 1993 (875,972).

  $\Rightarrow$ .55 tons x 90,800 housing starts = 49,940 tons of yard waste.

  $\Rightarrow$ 875,972 tons of yard waste (1993) + 49,940 tons of yard waste (increase from 1994 to 1998) = 925,912 tons of yard waste generated in 1998.

[13] *Statistical Abstract of the United States* (1994-1998), Tables on New Privately Owned Housing Starts Authorized, by State.

- The revised 1992 estimate of yard-waste generation found the following breakdown of leaves, grass, and brush as a percentage of yard waste generated in the state: 31% leaves, 64% grass, and 5% brush.
- Using these percentages, we can estimate the total amount of yard waste generated in 1998 (925,912 tons) that is comprised by leaves, grass, and brush.

Table 9-1: Generation of Yard Waste 1998 (Leaves, Grass, and Brush)

Type of Yard Waste	*%Total Yard Waste*	*Tons of Yard Waste Generated*
Leaves	31%	287,032
Grass	64%	592,584
Brush	5%	46,296
Total tons generated	**100%**	**925,912**

Yard-waste Diversion: 1998

- On-site diversion of yard waste includes allowing the materials to stay on the ground or taking them to the woods. It also includes composting materials, as well as chipping plant trimmings or brush.

  ⇒ The 1993 report assumed that multi-family homes have an on-site diversion rate that is one-half that of single-family homes[14].

- The sample of respondents in this survey is comprised of 85% single family residences and 15% multi-family dwellings. This breakdown is nearly identical to that reported in the 1990 U.S. Census (86% vs. 14%) and used in the 1993 report. Therefore, we employ the breakdown from this survey (85% vs. 15%) as a basis for calculating the relative proportion of yard waste generated by single and multi-family dwellings in Massachusetts.
- The average on-site diversion rates, and tonnage of leaves diverted, for all three types of yard waste are presented in the tables below.

[14] According to Note 3, Table 4-1 in "Quantification of Organic Waste Stream Components" (1993), the yard waste diversion percentage found through the resident phone survey is cut in half for all 2- to 4-unit buildings to account for the higher percentage of buildings that are not owner-occupied and yard waste is less likely to be managed on site.

Table 9-2: Diversion of Leaves: 1998

Total tons of leaves: 287,032

Type of dwelling	*% of Housing Units*	*Tons of Leaves*	*% Diverted*	*Tons Diverted*
Single-family	85	243,977	46.73	114,010
Multi-family	15	43,055	23.37	10,062
Total tons diverted				**124,072**

Table 9-3: Diversion of Grass: 1998

Total tons of grass: 592,584

Type of dwelling	*% of Housing Units*	*Tons of Grass*	*% Diverted*	*Tons Diverted*
Single-family	85	503,696	62.05	312,543
Multi-family	15	88,888	31.03	27,582
Total tons diverted				**340,125**

Table 9-4: Diversion of Brush/Trimmings: 1998

Total tons of brush/trimmings: 46,296

Type of dwelling	*% of Housing Units*	*Tons of Brush*	*% Diverted*	*Tons Diverted*
Single-family	85	39,352	31.96	12,577
Multi-family	15	6,944	15.98	1,110
Total tons diverted				**13,687**

- Therefore, in 1998, Massachusetts residents diverted an estimated 477,884 tons of yard waste from the MSW by handling it on site.

Table 9-5: Total On-site Yard-waste Diversion: 1998

Material	*Percent Diverted*	*Tons Diverted*
Leaves	43.23	124,072
Grass	57.39	340,125
Brush/trimmings	29.56	13,687
Total		**477,884**

- Consequently, Massachusetts households divert 52% of the total amount of yard waste generated in the Commonwealth (477,884/952,912 = 0.50 x 100 = 52%, with 925,912 representing the estimated total amount of yard waste generated from Table 9-1 above). The proportion of yard waste diverted is 4% higher than that reported in the revised 1992 estimate (48%).

This section describes the methodology used to quantify total generation and on-site diversion of food waste and the results of these calculations.

Food Waste in the MSW

An estimate of the quantity of food waste in the Massachusetts MSW forms the basis of the on-site diversion calculation.

- Because Massachusetts has not conducted a waste composition study, the quantity of food waste in the MSW must be estimated using secondary sources. This study elected to use the EPA estimate of the percentage of food waste in the MSW as a proxy for Massachusetts.
  - ⇒ The EPA estimates that 10.4%[15] of the national MSW is food waste.
  - ⇒ Applying the EPA estimate of 10.4% to the 1998 Massachusetts MSW of 7.36 million tons[16] yields an estimate of 765,440 tons in the MSW.

Table 9-6: Food Waste in the MA MSW

1997 MA MSW		*EPA Estimate of Food Waste in MSW*		*Food Waste in MA MSW*
7,360,000 tons	x	10.4%	=	765,440

[15] EPA Characterization of Municipal Solid Waste in the United States: 1997 Update, p. 5
[16] February 1999 Draft of the Massachusetts DEP 1998 Solid Waste Status Report, p.4, Table 1-1

⇒ The residential and commercial sectors each contribute one-half of the food waste in the MSW[17]. Therefore, the amount of food waste in the residential MSW is estimated to be 382,720 tons.

Table 9-7: Food Waste in the MA Residential MSW

Food Waste in MA MSW		*Residential Contribution to MSW*		*Food Waste in MA Residential MSW*
765,440	x	50%	=	382,720

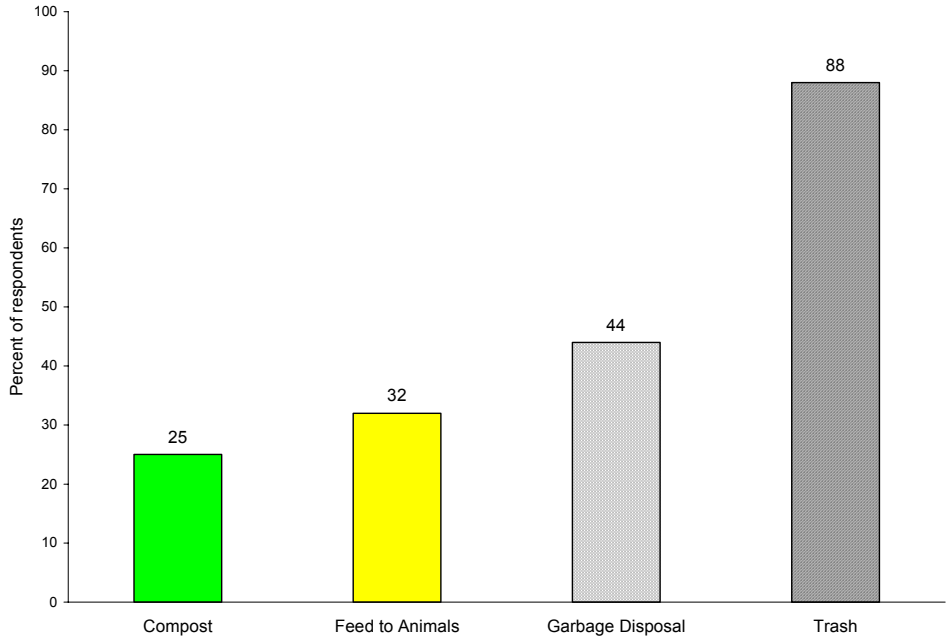
[17] Source: EPA Characterization of Solid Waste in the United States: 1994 Update, p. 161, Table C-1.

Food-waste Disposal Practices

The survey gathered data on both the methods residents use to dispose of food waste and the percentage of food waste disposed of with each method.

- As shown in the following chart, 25% of residents surveyed compost some food waste, 32% feed some food waste to animals, and 44% put some food waste in their garbage disposal[18].
- Nearly all residents put food waste in the household trash.

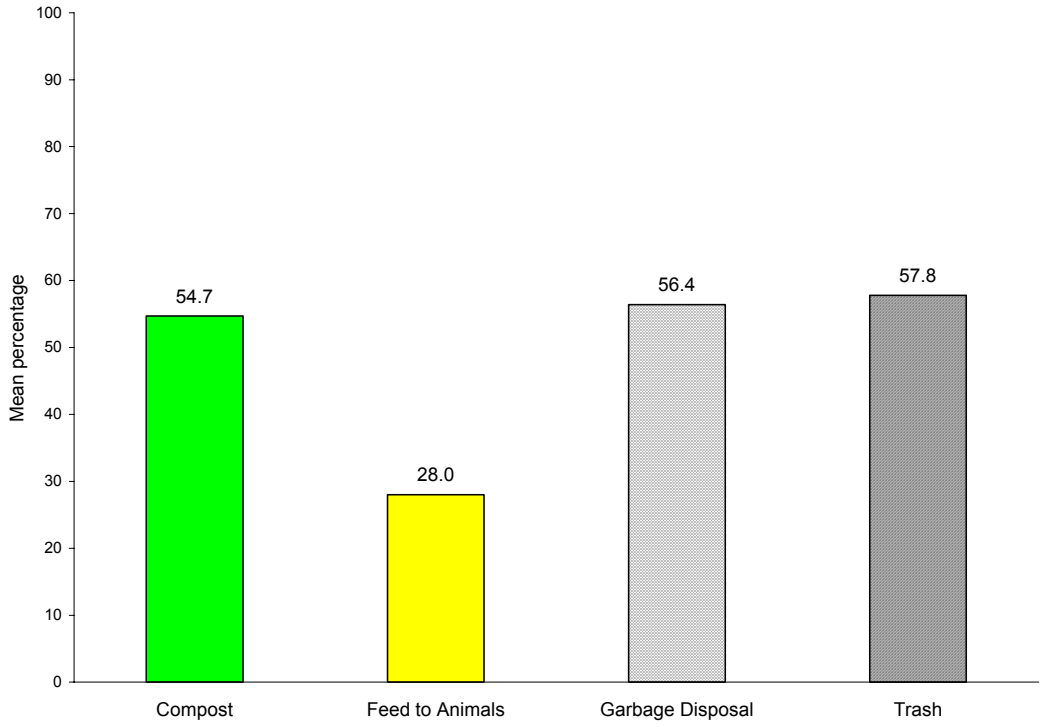
Food-waste Disposal Methods Used



[18] While 47% of respondents indicate they have garbage disposals, 7% of these respondents said they don't dispose of any food waste in their garbage disposal. Taken together, these results indicate that 44% of respondents use their garbage disposal for food waste.

- Among residents who compost, respondents estimate that more than one-half (54.7%) of their food waste is composted.
- Among residents with garbage disposals, an average of 56.4% of food waste is put in the disposal.
- Among residents who give food waste to animals, an average of 28% is fed to animals.
- Among residents that dispose of food waste in the household garbage, an average of 57.8% of food waste goes into the household garbage.

Average Percentage of Food Waste Disposed of with Each Method



Using the survey results for the method residents use to dispose of food waste and the percentage of food waste disposed of with each method, we can estimate the percentage and tonnage of food waste disposed of with each method.

The method for calculating the percentage of all food waste disposed of with each method is illustrated below, using the composting figures as an example. This method is also used to calculate the percentage of food waste disposed of in the household garbage, put in garbage disposals, and fed to animals.

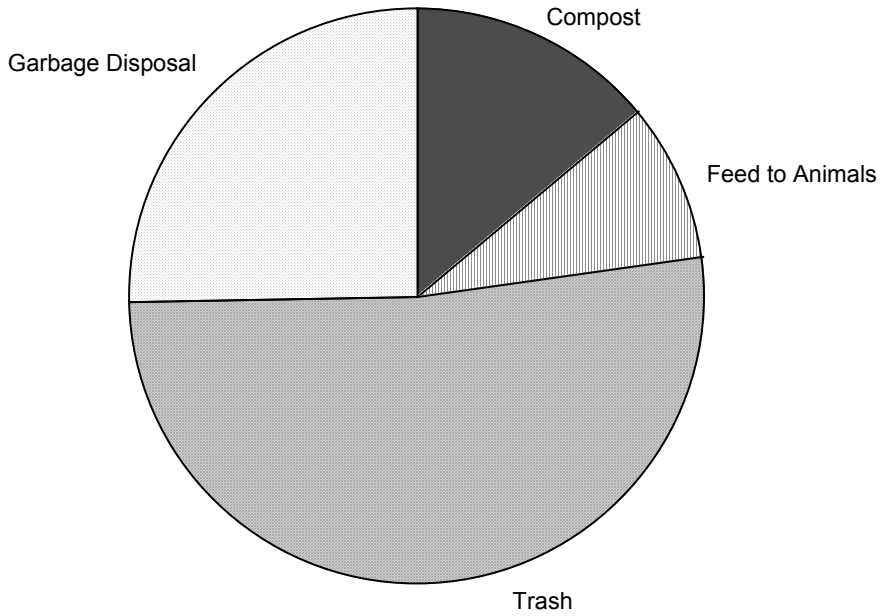
Percent of All Food Waste Composted	**=**	**(% of Respondents Composting) (Average % Composted)**	
13.7%	=	(25%)	(54.7%)

The results of these calculations are illustrated in the table and figure below.

- 13.7% of all residential food waste generated is composted, and another 8.9% is fed to animals.
- About one-half (50.9%) of food waste is put in the household garbage, and another 24.9% goes down garbage disposals.

Table 9-8: Percent of All Food Waste Disposed of through Composting, Animals, Garbage Disposal, and the Trash

Compost	*Animals*	*Trash*	*Garbage Disposal*
13.7%	8.9%	50.9%	24.9%



This survey only sampled households that have and maintain a yard. It is unlikely, however, that the food-waste on-site diversion rates for households *with* yards are directly applicable to households without yards. Households without yards (typically multiple-family dwellings) are less likely to have sufficient outdoor space to compost food waste or to have animals.

- To develop a more realistic estimate of food-waste on-site diversion among multi-family dwellings, the level of food waste composting and feeding of food waste to animals in multi-family dwellings is assumed to be one-half the level seen in single-family homes.
- The amounts subtracted from the compost and animals categories need to be re-allocated to trash and garbage disposals so that all food waste is included in the calculation.

  ⇒ Because households put about twice as much food waste in the trash as they do in the garbage disposal, the compost and animal portions are reallocated to trash and garbage disposals at a 2:1 ratio. Using the compost category to illustrate, 4.6% of the 6.85% subtracted from compost is added to trash, and 2.3% is added to garbage disposal. (The calculations for multi-family dwellings' food waste diversion rates are discussed in more detail in the Technical Appendix of this report.)

Table 9-9: Percent of All Food Waste Disposed of through Composting, Animals, Garbage Disposal, and the Trash (Multi-Family Dwellings)

Compost	*Animals*	*Trash*	*Garbage Disposal*
6.85	4.5	58.5	28.7

In order to apply the single-family and multi-family disposal rates to the MSW tonnage figure, we must first allocate the MSW tonnage between the two types of housing. The most appropriate way to allocate the tonnage is based on an estimate of the percent of the state's population living in multi-family vs. single-family homes.

- According to 1990 Census figures on the number of single-family and multi-family households, and the average number of persons per housing unit, 54% of the state's population lives in single-family homes while 46% lives in multi-family dwellings.

  ⇒ Therefore, 54% of the food waste in the residential MSW is generated by single-family homes (206,669 tons) and 46% is generated by multi-family homes (176,051 tons).

Food waste in the MSW is equivalent to what residents put in the trash, and therefore represents only a portion of all food waste. Using the survey results, we can estimate the percentage of all food waste in the residential MSW. This estimate is then used to calculate the total tonnage of food waste generated and the tonnage of food waste that is diverted on site from the MSW.

To calculate total residential food waste generation:

Total tons of Food Waste Generated = (Tons of Food Waste in MSW) / (Percent Food Waste in MSW)

⇒ This calculation is done within the single-family and multi-family groups and then summed to yield the overall total.

⇒ The methodology used to calculate total residential food waste generation is very similar to the way Tellus calculated yard-waste generation (see Table 2 of their August 6, 1999 memorandum). The "Percent Food Waste in MSW" is equivalent to Tellus' "Generation Adjustment Factor (1 minus On-site diversion percentage)" shown in Table 2 of the memo.

The following three tables show total food waste generation for the state, as well as for the single-family and multi-family dwelling categories. The tonnage of food waste composted, fed to animals, put in the trash, and in garbage disposals are also displayed.

- Massachusetts residents generated 706,971 tons of food waste in 1998. Divided by the number of residents in Massachusetts (6,147,132), each resident produces 0.63 pounds of food waste each day.
- 76,241 tons of food waste were composted on site by residents in 1998.

Table 9-10: Tonnage Calculations: State Total

Method	***Proportion***	***Tons***
Compost	0.108	76,241
Animals	0.070	49,679
Trash	0.541	382,720
Disposal	0.265	187,471
Total	0.985	696,111
Rounded total	**1.0**	**706,971**

Table 9-11: Tonnage Calculations: Single-Family Segment

Method	***Proportion***	***Tons***
Compost	0.137	55,626

Animals	0.089	36,137
Trash	0.509	206,669
Disposal	0.249	101,101
Total	0.984	399,533
Rounded total	**1.0**	**406,029**

Table 9-12: Tonnage Calculations: Multi-Family Segment		
Method	***Proportion***	***Tons***
Compost	0.0685	20,615
Animals	0.045	13,542
Trash	0.585	176,051
Disposal	0.287	86,370
Total	0.986	296,578
Rounded total	**1.0**	**300,942**

Paper waste composting

This survey also asked respondents if they compost some types of paper waste[19] generated by their household. This data is used to develop an estimate of the quantity of paper waste composted by households in Massachusetts.

⇒ Only 4% of households surveyed compost some portion of their paper waste. This represents a very small group of respondents (n=15), and as a result, the paper waste composting data presented here should be viewed as a qualitative.

As described in Section IV, after being asked whether or not they compost specific types of paper waste, respondents were asked to estimate what percent of these types of paper waste they compost.

- Respondents compost an average of 41% of the compostable paper types described in the survey.

To estimate the percent of paper composted, the average percent composted (41%) is multiplied by the percent of households that compost paper (4%). Based on this calculation, 2% of the paper in the categories described in the survey is composted.

Percent of Paper Waste Composted	=	(% of Respondents Composting)	(Average % Composted)
2%	=	(4%)	(41%)

[19] Households indicating they compost any paper waste were asked if they compost the following types of paper: paper towels, paper napkins, tissue paper, coffee filters or tea bags, wax paper, paper plates, or paper bags. Eight of the 15 paper composting households we surveyed volunteered that they also compost newspaper.

Paper and paperboard comprise an estimated 38.1% of the MSW.[20] Paper waste described as compostable in the survey comprises an estimated 7% of the MSW.

- Applying the EPA estimates (7% compostable paper waste) to the Massachusetts MSW (7,360,000 tons[21]) yields an estimated 515,200 tons of compostable paper waste in the MSW (includes both residential and commercial).

Paper and Paperboard products in US MSW, 1996		
	Thousands of Tons	**Percent of MSW**
Compostable paper		
Bags and sacks	1,980	
Tissue paper and towels	2,980	
Paper plates and cups	950	
Newsprint	9,810	
Total compostable	15,720	7%
Other paper/paperboard	64,210	
Total paper/paperboard	79,930	38.1%
Total MSW	**209,660**	**100%**
Source: Characterization of Municipal Solid Waste in the United States: 1997 Update, p. 30, Table 4		

- Research indicates that the residential sector generates 40% of all paper waste and the commercial sector produces 60%. Therefore, 206,080 tons of compostable paper waste in the MSW is generated by the residential sector.[22]

[20] *EPA Characterization of Municipal Solid Waste in the United States: 1997 Update*, p. 5
[21] Massachusetts DEP 1998 Solid Waste Status Report, p. 4, Table 1-1

As indicated in discussions of yard and food waste above, we estimate that multi-family dwellings divert waste on-site at one-half the rate of those living in single-family homes. Hence, single-family dwellings compost 2% of their paper waste, while multi-family dwellings compost 1% of their paper waste.

- As indicated in an earlier section of this report, an estimated 54% of the state's population lives in single-family homes and the remaining 46% of the population lives in multi-family homes.
- Applying these percentages to the total amount of residential paper waste generated in the MSW, single-family households generate approximately 113,554 tons of compostable paper waste while multi-family homes generate approximately 95,755 tons.

  ⇒ Applying composting percentages to these tonnages yields an estimate of 3,229 tons of paper waste composted by Massachusetts residents.

Tons of Paper Waste Composted

	Percent of Households	Tons of Compostable Paper in MSW	Percent Composted	Tons of Compostable Paper Generated	Tons Composted
Single-family	54	111,283	2%	113,554	2,271
Multi-family	46	94,797	1%	95,755	958
Total		**206,080**	**--**	**209,309**	**3,229**

[22] Calculated from data in Franklin Associates, *Solid Waste Management at the Crossroads*, 1997.

Technical Appendix: Notes on Quantification Methodology

Yard-waste Diversion Calculations

- This research followed the methodology of the 1993 report (see 1993 report Table 2-1) to calculate the percentage of leaves, grass, and brush diverted on site by Massachusetts residents.
- Survey results are used to make calculations within each category of yard waste (leaves, grass, and plant trimmings or brush) and by each on-site management technique (leaving on ground or taking to woods, composting, and wood chipping for plant trimmings and brush).
  - ⇒ First, we calculate the total number of respondents who engage in one of the on-site management techniques for each type of yard waste.
  - ⇒ Second, we use survey results to indicate the amount of yard waste residents treat in each manner (less than ¼, ¼ to ½, ½ to ¾ , or more than ¾).
  - ⇒ Third, we multiply the number of respondents in each proportion category (e.g. less than ¼, ¼ to ½, etc.) by the midpoint of the proportion range. The midpoint of the less than ¼ proportion = 0.125; ¼ to ½=.375; ½ to ¾ = 0.625; more than ¾ (including "all") = 0.875. This results in a subtotal of respondents for each proportion category.
  - ⇒ Fourth, we add the subtotal of respondents together and divide this number by the total number of respondents who practice the particular form of on-site management of the particular type of yard waste (leaves, grass, or brush). This results in a number indicating the average percentage of yard waste diverted among those who divert yard waste.
  - ⇒ Fifth, this number is multiplied by the proportion of all respondents who have the particular type of yard waste. This calculation yields the overall percentage of yard waste diverted for each category of yard waste by single-family households. Separate totals are calculated for leaving

materials on the lawn or taking them to the woods and composting. These totals are then added together to arrive at the total percentage of yard waste diverted for each category of yard waste.

⇒ This series of calculations yields the percentage of yard waste diverted onsite by single-family households. Consistent with the 1993 methodology, diversion rates for multi-family dwellings with 2-4 units are estimated to be one-half (.5) of the single-family rate. Multi-family dwellings with more than four units are estimated to divert none of their yard waste onsite.

- An example of this methodology, using the data on leaves residents let stay on the ground or take to the woods, is provided below. This methodology is replicated for all three types of yard waste: leaves, grass, and plant trimmings or brush. It is carried out on all ways residents divert yard waste on site: letting waste stay on the ground or taking it to the woods, composting, and wood chipping plant trimmings or brush.

Leaves: Let stay on ground or take to woods (Example)

Total who practice diversion method: 143			
Proportion of all respondents who practice method: .143/387 = 0.369 (387=total number respondents)			
Amount diverted	***Number who divert***	***Multiplier***	***Subtotal***
Less than ¼	26	0.125	3.25
¼ to ½	13	0.375	4.88
½ to ¾	24	0.625	15.00
More than ¾/all	80	0.875	70.00
Sum of subtotals			93.13
Average percent diverted (93.13/143)			**65.12**
Total percent diverted (65.12 x 0.369)			**24.06**

Using this methodology for each disposal method within each category of yard waste, the on-site diversion rate for leaves, grass, and brush is calculated.

- As shown in the table below, 46.73% of leaves, 62.05% of grass, and 31.96% of brush were diverted on site in 1998 by single-family households.
- The percentage of yard waste managed on site has increased slightly since 1993 within each category of yard waste.
- Of the three types of yard waste, on-site diversion of grass has increased most (up 4 percentage points to 62.05).

Percentage of Yard Waste Diverted Through On-site Management: Single-Family Households

	Leaves	***Grass***	***Brush***
1998	46.73	62.05	31.96
1993	45.36	58.05	31.85

The tables showing the full calculation of the on-site diversion percentages for yard waste are shown on the following two pages.

PERCENTAGE OF YARD WASTE DIVERTED THROUGH ON-SITE MANAGEMENT: SINGLE-FAMILY DWELLINGS

Total with yards=387

Yard waste on ground	LEAVES			GRASS		BRUSH	
		multipler (1)	subtotal		subtotal		subtotal
Total responding (2) =	143			191		105	
Diverting							
<1/4	26	0.125	3.25	25	3.13	15	1.88
1/4-1/2	13	0.375	4.88	21	7.88	11	4.13
1/2-3/4	24	0.625	15.00	38	23.75	21	13.13
>3/4	80	0.875	70.00	105	91.88	57	49.88
Average percentage diverted by those who leave on ground/take to woods (3)			65.12		66.30		65.71
Percentage of total YW diverted this way (4) (based on 387 respondents)			24.06		32.72		17.83

Yard waste chipped or taken to woods		GRASS (woods)		BRUSH (chipped)	
	multipler (1)		subtotal		subtotal
Total responding (2) =		96		41	
Diverting					
<1/4	0.125	20	2.50	16	2.00
1/4-1/2	0.375	16	6.00	14	5.25
1/2-3/4	0.625	21	13.13	4	2.50
>3/4	0.875	35	30.63	5	4.38
Average percentage diverted by those who leave on ground/take to woods (3)			54.00		34.00
Percentage of total YW diverted this way (4) (based on 387 respondents)			12.96		3.74

Home Composting:	LEAVES			GRASS			BRUSH		
Total responding =	160			118			82		
Diverting									
<1/4	28	0.125	3.50	24	3.00		21	2.63	
1/4-1/2	30	0.375	11.25	24	9.00		21	7.88	
1/2-3/4	30	0.625	18.75	18	11.25		14	8.75	
>3/4	62	0.875	54.25	47	41.13		24	21.00	
Average percentage diverted by those who compost			54.84		54.56			49.09	
Percentage of total YW diverted this way (based on 387 respondents)			22.67		16.37			10.40	
Total percentage diversion			**46.73**		**62.05**			**31.96**	

1) Multipliers derived by midpoint of range
2) Numbers of individual responses may not add up to the total number of survey responses due to incomplete survey responses.
3) Weighted average of responses.
4) Calculated by multiplying the fraction of respondents to each question by the weighted average percentage c (e.g. for leaves on ground/taken to woods: 193/447 x 71.57% = 30.9%)
5) The single-family diversion rates are multiplied by 0.5 for multi-family dwellngs with 2-4 units. Multi-family dwellings with more than 4 units are assumed to divert none of their yard waste onsite.

Calculating food waste disposal percentages for multi-family dwellings

As discussed in Section IX of this report, residents in multi-family dwellings are assumed to divert food waste on site at lower rates than people in single-family homes. To estimate on-site diversion rates for multi-family homes, the rates at which food waste is composted and fed to animals is assumed to be one-half that seen among single-family homes. Correspondingly, the rates at which residents of multi-family dwellings dispose of food waste in the household trash and garbage disposal are higher than that seen in the single-family segment.

The calculations used to adjust the portion of food waste residents in multi-family dwellings compost, feed to animals, put in the household trash or in garbage disposals are illustrated below.

MF Composting Rate = (SF Composting Rate) (0.5)

6.85 = (13.7) (0.5)

MF Feed to Animal Rate = (SF Feed to Animal Rate) (0.5)

4.5 = (8.9) (0.5)

MF Put in Trash Rate = (Composting remainder) (Ratio of Trash vs. Disposal rate) + (Feed to animals remainder) (Ratio of Trash vs. Disposal rate) + (SF Estimate of % put in trash)

58.5 = (6.85)(0.67) + (4.5) (0.67) + 50.9

MF Put in Disposal Rate = (Composting remainder) (Ratio of Disposal vs. Trash rate) + (Feed to animals remainder) (Ratio of Disposal vs. Trash rate) + (SF Estimate of % put in disposal)

28.7 = (6.85)(0.33) + (4.5) (0.33) + 0.249